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ELECTRONICS AND ELECTRICAL ENGINEERING

No. 87

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Electronics and Electrical Engineering

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AMPLIFIERS

DIFFERENTIAL MEASURING AMPLIFIER WITH CONTINUOUS COMPENSATION OF BIAS VOLTAGE
BASED ON INTEGRATED MICROCIRCUITS

PRYANISHNIKOV, V. A. and NOVIKOV, N. G.

[Abstract] A differential measuring amplifier with continuous compensation
of bias voltage based on integrated microcircuits was developed by the authors
in accordance with a structure presented in a 1975 work from the literature.
The amplifier, a block diagram of which is presented, consists of two parallel
channels: a primary broad-band amplifier and a compensating amplifier. A
K284U1A microcircuit is used as the primary amplifier, and a Type M-DM ampli-
fier is constructed on the base of this same microcircuit. The results of
experimental investigations agree quite well with calculated values and show
that the amplifier developed can be used as a differential measuring amplifier
in the direct-current frequency band as far as 20kHz. The paper was recommended
by the Department (Kafedra) of Electrical Engineering, Leningrad Institute of
Precision Mechanics and Optics. Figures 3; references: 5 Russian.
[348-6415]

1

RADIATION FROM PLANE CLOSED ARRAY OF MONOPOLE AND DIPOLE POINT SOURCES

FEDORYUK, M. V.

[Abstract] The steady-state wave field produced by wave potentials of electric
simple and double layers is analyzed, the variation in time being characterized
by the factor $e^{-j\omega t}$ and the ambient space being filled with an isotropic homo-
geneous medium. For the solution of the problem, the wave potentials are re-
placed with N pairs of monopole and dipole point sources around a closed curve L
(circle) or on a closed smooth surface S (sphere). Such arrays are used in
radio engineering for active suppression of sound, the radiation from it being
controlled by means of an external field. Here, for simplicity, this external
field is produced by a point source at the center of the array, where the origin
of the coordinates is also placed. The calculations are based on the classical
theory of antennas. The asymptotic behavior of the residual field is determined
with the homogeneous Helmholtz equation used as reference or, in a more accurate
approximation, by the method of steepest descent. Figures 2; references 9:
7 Russian, 2 Western (one in translation).
[365-2415]

CHANGE OF PARAMETERS OF WEAKLY-DIRECTIONAL ULTRASHORT WAVE ANTENNAS IN
COLLIMATOR FIELD

KAPLUN, I. V. and KOLOSOV, Yu. A.

[Abstract] The paper considers the distinctive features of a calculation of
the parameters of collimator measuring equipment intended for tests of weakly-
directional ultrashort wave antennas. The fundamental relations for calculation
of collimator parameters are described and an analysis is made of the errors of
measurement of the directivity pattern (DP) and the requirements on the param-
eters of the collimator. It is concluded that the analysis of errors presented
in the paper and the method considered for calculation of the collimator param-
eters can be used during planning of collimator measuring equipment, which
assures the necessary precision of measurement of the DP of weakly-directional
antennas. Figures 4; references 4: 3 Russian, 1 Western in translation.
[339-6415]

ELECTRICAL CONTROL OF POLARIZATION OF RADIATION BY PLANE LOGARITHMIC SPIRAL

YATSUK, K. P. and KRIVOKHIZHA, V. P.

[Abstract] Plane logarithmic spirals pertain to a class of wide-band antennas
with circular polarization of the radiation field. In order electrically to
control the polarization in a wide band of frequencies, it is proposed to place
the spiral on a ferrite layer with a shield and a controlling magnetic field,
normal to the plane of the spiral. The problem of excitation of nonsymmetrical
waves in the spiral is considered. For experimental discovery of the effect
of control of polarization of a radiated field and determination of the direc-
tional energetic characteristics of the proposed system there was taken an
arithmetical spiral with a diameter of 200 mm with spacing of the winding of
4.5 mm on a layer of fiber glass laminate. The proposed method of recording
solutions of the Maxwell equations in a gyrotropic medium in the form of a
Fourier-Bessel expansion made it possible to analyze the radiation of a plane
spiral on a gyrotropic shielding layer. The system described assures electrical
rearrangement of the polarization of the radiated field in the far zone in the
limits of 0.1 to 1. With a controlling magnetic field up to 1000 oersted the
working band width of the antenna with controlled polarization amounts to one

octave. The possibility of electrical control of polarization in a wide-band
of frequencies is confirmed. Figures 3; references 5: 3 Russian, 2 Western
in translation.
[331-6415]

ANALYSIS OF LOG-PERIODIC DIPOLE ANTENNA IN PLANE PHASED ARRAY

YATSKEVICH, V. A. and LAPITSKIY, V. M.

[Abstract] Log-periodic antennas as radiators with a theoretically nonrestric-
ted frequency band can serve as a basis for construction of highly-directional
wide-range antenna arrays. A superwide-band phased array with a rectilinear
equidistant geometry and compact arrangement of elements, with which an absence
of secondary maximums in the working frequency band is assured, can be construc-
ted from log-periodic dipole antennas (LPDA). A scheme for an arrangement of
LPDA is presented which makes it possible to expand the range of the system
to the low-frequency side with the condition that the action of the coupling
does not lead to distortion of the frequency-independent characteristic of the
radiation. The method of analysis is based on the model of an infinite array.
A more detailed analysis of this problem and recommendations with respect to
the choice of the radiator of a wide-band phased array will form the subject
of a separate investigation. Figures 2; references 7: 5 Russian, 2 Western
in translation.
[331-6415]

RESULTS OF NUMERICAL SOLUTION OF MIXED PROBLEM OF SYNTHESIZING ACOUSTIC ANTENNAS
USING CYLINDRICAL BODY

ALEKSEYEV, G. V. and TAKHTEYEV, V. A.

[Abstract] Numerical calculations of the reverse problem of synthesis of acoustic
antennas in a cylindrical shield show that the presence of the cylinder leads to
the appearance of imaginary components in the solution which causes difficulties

in the technical realization of the corresponding antennas. In order to avoid these difficulties, a preliminary assignment is advisable for a solution or for some limitations on it. In this way a mixed problem appears for synthesizing an antenna with limitations on the phase of the oscillation rate. The object of the present brief communication is the development of a numerical method of solution of the mixed problem mentioned, with symmetrical initial data on the basis of the methods of quantization and regularization proposed in a 1978 paper from the literature. The communication also investigates the solution of the wave dimensions of the cylindrical shield and the antenna. It is shown that the solution obtained can readily be realized in practice in the form of multiring discrete antenna in a cylindrical shield. Figures 2; references: 5 Russian. [331-6415]

INPUT IMPEDANCE OF RING-SHAPED RESONATOR-SLOT ANTENNA ON SPHERE WITH SHEATH

SHUNIN, O. A.

[Abstract] During planning of weakly-directional slot antennas for aircraft the problem arises of determining the input impedance, the amplitude-phase distribution of the field and other electrodynamic characteristics of the antenna-feeder device, with the effect of the dielectric coating taken into account. At present the problem in question is most fully considered when applied to an infinitely extended plane layer of dielectric or plasma. Use of a mathematical model in the form of a sphere with a dielectric layer makes it possible to take into account the curvature of the surface of the metal fuselage of an aircraft. The results obtained in this brief communication make it possible to ascertain the regularity of the effect of the structural parameters of the amplitude-phase distribution (APD) of the field and the thickness of the spherical layer of the dielectric on the input impedance and the APD of the ring-shaped resonator-slot antennas, as well as to fulfill numerical calculation of the radiators of a given type. It is concluded that the numerical algorithm, program and methods of calculation described make it possible to accomplish machine design of ring-shaped resonator-slot antennas located on a spherical surface with a uniform dielectric layer. Figures 4; references 4: 1 Russian, 3 Western. [331-6415]

EXPERIMENTAL STUDY OF REFLECTOR ANTENNA DIRECTIVITY CHARACTERISTICS BY
AMPLIPHASOMETRIC METHOD

BELOV, Yu. I., VEKSLER, N. V., KOROTKOV, V. S., MAL'TSEV, V. P., SADOVNIKOV, A. P.,
SEMENOVA, L. R., TURCHIN, V. I., FOGEL', A. L., TSEYTLIN, N. M. and
SHCHEGLOV, K. S.

[Abstract] Fundamental relations are established for calculating the two space
components of the radiation pattern from amplitude and phase measurements of
the angular distribution of the field intensity in the near zone. Actual
measurements of the azimuthal radiation pattern for a fully rotatable 2-reflector
parabolic antenna with elliptical polarization were made with instrumentation
consisting of a reference receiver antenna and a transmitter horn fed from a
generator. The total measuring time required to determine the near-field matrix
for this antenna with a time constant of 0.1 s was 2 h, a favorable factor being
the only very small cross-polarization component. Both the sum pattern with the
maximum on the antenna axis and the difference pattern with the minimum on the
antenna axis were produced, the former by cophasal excitation and the latter by
antiphasal excitation of two radiator pairs. These patterns restored with the
aid of a BESM-4 digital computer are found to have weaker side lobes than
patterns restored from measurements by the focusing method. Figures 8; tables 2;
references: 12 Russian.
[336-2415]

MUTUAL IMPEDANCE AND EFFICIENCY OF VERTICAL DIPOLES ABOVE SEPARATION BOUNDARY

SENKEVICH, S. L. and SODIN, L. G.

[Abstract] A pair of identical vertical dipoles an arbitrary distance apart
are spaced above the ground with an intervening separa lon boundary. It is
assumed that the dipoles are driven with a sinusoidal irrent distribution and
the plane boundary separates two homogeneous media; excitation is not
necessarily symmetrical. Rigorous analytical express... s are derived for the
mutual impedance and radiation resistance, which make it possible to determine
the efficiency of such vertically polarized antenna systems, taking the separa-
tion boundary into account. The derived equations are illustrated with calcu-
lations of the efficiency and mutual impedance of identical half-wave and
quarter-wave dipoles. The efficiency is plotted as a function of the height

of the dipoles above ground as is the input impedance of the half-wave dipole.
As soon as the height of the dipoles becomes greater than a half-wavelength, the
impedance assumes its steady state value which is quite close to the free space
impedance. The results from these rigorous formulas differ considerably from
earlier Soviet data for the values of Re(Z) as a function of the height-to-
wavelength ratio for small values of this ratio; it is recommended that the given
expressions be used for calculating these antenna characteristics, even for
complex antenna systems, including phased arrays. Figures 3; references 8:
5 Russian, 3 Western.
[334-8225]

CHARACTERISTICS OF RADIATION FROM STRIPLINE DIPOLES

PANCHENKO, B. A. and SHABUNIN, S. N.

[Abstract] Stripline antennas are increasingly used as single radiators or
elements in arrays, although the presence of a dielectric layer and the
attendant generation of surface waves complicate the radiation mechanism.
Here the solution to the relevant problem of electromagnetic excitation of the
boundary between two media is sought directly in the form of a series of natural
modes in a nonhomogeneous cross section. The scalar component of Green's tensor
function appears in the form of a finite sum of eigenfunctions in the discrete
part of the spectrum and the integral of functions in the continuous part of the
spectrum, with roots of a system of transcendental equations. The solution is
simple and yields the impedance, the sum of three components: one associated
with a TM surface wave, one associated with a TE surface wave, one associated
with volume waves. On this basis the power radiated by the waves of each type
as well as the entire radiation pattern is calculated. The method and the
results are demonstrated on a rectangular stripline vibrator of length b and
width a, with the surface density of the electric current

$$\vec{J}(y,z) = \frac{I_0}{a}\cos\frac{\pi}{b}y\,\vec{e}_y = J(y,z)\vec{e}_y$$ (where $\vec{e}_y$ denotes the unit vector in the y-direc-

tion). For such a dipole is also determined the dependence of its efficiency
on the dielectric permittivity of the substrate and its impedance (resistance,
reactance) on its length. Figures 5; references 7: 2 Russian, 5 Western
(two in translation).
[365-2415]

SYNTHESIZING ANTENNA ARRAYS WITH PASSIVE ELEMENTS AND SPECIFIED SIDE RADIATION
LEVEL

PAVLYUK, V. A. and RYBALKO, A. M.

[Abstract] In planning radiating systems it is often necessary to solve a
problem of compromise synthesis, i.e., to determine the amplitude-phase distribu-
tion of current in an antenna with respect to a specified directional diagram
[DD] E_0 (φ, θ) with additional requirements. The requirements which determine
the area of the permissible currents D, can relate to both the DD and to the
current distribution of the antenna. In the present work, the authors consider
the area D, which is determined by the presence of passive elements in the anten-
na array (AA) and by suppression up to the level of the side lobes of the DD in
a discrete set of directions or in a set of solid angles. Choice of the direc-
tion can be the result, for example, of the directions of arrival of intense
interference. An optimum amplitude-phase distribution of the current in the AA
is realized. With respect to the current distribution already obtained, the
optimum DD is found from the point of view of a mean square approximation.
During synthesis of the DD of an antenna with suppression of the radiation
power in a specified zone, the approximation method is found to be unsuitable
because in the case considered the number of points of suppression is limited
by the number of elements in the array. Consequently, an efficient method of
suppression is also developed for this case. Proposed algorithms for optimiza-
tion of the DD of antenna arrays are transferred to the problem of determing
the extremal values of the integral parameters (amplification factor, concentra-
tion factor, etc.). The directivity of antenna arrays with dimensions shown
in the report have, in contrast to the AA, only active elements with large
resistance to fluctuations of the antenna parameters. Figures 1; references:
6 Russian.
[328-6415]

EFFECT OF CORRUGATED STRUCTURES ON INTERACTION OF WEAKLY-DIRECTED ANTENNAS

MARTSAFEY, V. V. and SHVAYKO, I. G.

[Abstract] At present in radio engineering wide use is made of a group of
weakly-directed antenna radiators of the open end waveguide type which have

a common flange. In order to decrease the interaction of these antennas im-
pedance structures are often used, located between them. Ribbed structures
are most widely used. The impedance concept has found wide application in the
treatment of the operation of uncoupling of structures. Because the impedance
concept is approximate, an analysis is made of the operation of ribbed struc-
tures within the framework of correct methods. The problem of aperiodic exci-
tation of an infinite packet of plane semi-infinite waveguides is examined.
Then the problem is disucssed of two waveguides with a common flange and a
ribbed structure between them with short circuitry of both the interiors
(lying between the antennas in question) and part of the exteriors of the
waveguides. The dependence of the coupling coefficient and the change of the
radiation pattern on the electrical characteristics of the impedance structure
is determined for a two-dimensional model. Figures 4; tables 1; references 7:
5 Russian, 2 Western in translation.
[331-6415]

CONSIDERATION OF MUTUAL EFFECT OF RADIATORS DURING ANALYSIS OF STEADY-STATE
REGIME OF ADAPTIVE ANTENNA ARRAYS

SAZONOV, D. M. and SHCHAPOV, Yu. M.

[Abstract] This paper is concerned with an investigation of the characteristics
of a steady-state regime of adaptive antenna arrays (AAA) on the basis of a more
realistic mathematical model of an antenna array with rigorous consideration of
the mutual effect of its elements. Construction of the mathematical model is
accomplished on the base of the matrix theory of antenna arrays advanced in
1969 and 1975 papers of which Sazonov was the principal author. The AAA can
have an arbitrary geometry and the problem consists in determination of the
maximum achievable signal-to-noise ratio at the output of the adding device and
the corresponding directivity pattern as a function of the interference condi-
tion and the characteristics inherent in the antenna array. The structural
arrangement of the AAA is considered, including the inherent antenna array, at
the output of each element of which a receiving device with a controlled complex
transfer function is installed. The optimum set of such coefficients which are
formed by the system processor, must assure the maximum signal-to-noise ratio
at the output of the coherent adding device under the conditions of the changing
interference of the arrangement. Because part of all the circuit of the AAA to
the inputs of the receivers is a microwave channel, then for a description of
the passage of signals it is natural to use the mathematical apparatus of the
theory of linear microwave signals. The proposed mathematical model makes it
possible to decrease the properties of the AAA in a steady-state regime with a

rigorous consideration of the mutual effect of radiation in the array. On the basis of the use of a scattering matrix of the antenna array it was possible to obtain quantitative dependences which are the totally determining characteristics of a steady-state regime of an AAA. The proposed method of calculation remains valid for the most general case of an arbitrary geometry of the AAA, with various types and orientations of its elements, as well as for all kinds of interference situations. The matrix model makes it possible subsequently to analyze a whole series of effects which it is impossible to describe in the space of the theory of AAA existing up to this time, because of the effect of mismatch of receivers in AAA channels, analysis of the effects of superdirectivity and other items. The algorithms developed for the solution of the problem of analysis of a steady-state regime of an AAA are easily programmed for conducting calculations of a computer and make it possible for the developer to choose the most efficient design for an antenna array at the stage of planning adaptive antenna systems. Figures 4; references 11: 9 Russian, 2 Western.
[331-6415]

COHERENT-OPTICAL PROCESSOR OF ANTENNA ARRAY RADIO SIGNALS

VORONIN, Ye. N., GRINEV, A. Yu. and TEMCHENKO, V. S.

[Abstract] After reviewing a number of papers from the literature concerned with antenna arrays (AA) with coherent-optical processing of a signal, the authors describe their experimental verification of the results of some of this work, and give an evaluation of the practical possibility of implementing such systems. The investigations were conducted on an installation which includes a He-Ne laser, a collimator, an imitator of the signal of a 16-element AA, polarizer, analyzer, an electrooptical element, an objective ($f = 0.6$ m), a photoelectric transducer (FEU-28), and a recording device. The imitator includes diriving oscillators (corresponding to specific targets), a 16-channel amplifiers with separate control of the amplitude (0 to 50 V) and phase (from 0 to 360° with discreteness of 3°). At an intermediate frequency, it is possible to simulate any combination of signals of a linear 16-element AA. The electrooptical element (space-time light modulator) consists of two identical plates ($16 \times 8 \times 0.5$ mm^3) of single crystal lithium tantalum of a 90° cut, on which are deposited 32 parallel electrodes 250 micrometer wide at 400 micrometer intervals. For thermocompensation between crystals, a half-wave plate is installed; the half-wave voltage of the modulator is 70 ($\pm$ 5) volts. A comparison is made of the theoretical and experimental results with respect to the shaping of the angular spectrum of a radio signal with suppression of the combined image and frequency selectivity of the processor with an "equivalent" lens at the level of the AA. Figures 4; references 9: 8 Russian, 1 Western.
[319-6415]

SYNTHESIZING OPTIMUM ANTENNA ARRAY WITH RANDOM ERRORS TAKEN INTO ACCOUNT

BUBNOV, G. G., DOZORETS, L. A. and TROSHKO, O. R.

[Abstract] A method of synthesis of amplitude-phase distribution (APD) is
proposed, which assures a minimum level of minor lobes (LML) of a normalized
average radiation pattern. An optimum APD makes it possible to increase the
directivity of phased antenna arrays (PAA) in comparison the Dolph-Chebyshev or
"cosine-square on a pedestal" amplitude distributions, during which the advan-
tage is more substantial than with the smaller array spacing and the errors of
the APD. Thus, for example with the array spacing $d = 0.233 \lambda$ and the mean square
error $= 7°$, it is possible either to decrease the LML to 7-10 dB, to narrow
the main lobe by 15-20% or to reduce the length of the PAA by 15-20%. Even the
existence of moderate errors of APD, the parameters of the directivity pattern
practically does not depend on the number of dipoles in the aperture, and are
determined solely by the length of the antenna. In particular, the convergence
of the elements at a distance d, the smaller half-wave length, does not lead to
an increase of the directivity in comparison $d = 0.5 \lambda$. Shared arrays ($d < 0.5 \lambda$)
with an APD nonoptimum for a given array spacing (in particular Dolph-Chebyshev)
with the presence of errors is inferior to the directivity of an optimum array
of the same length with a spacing of $d = 0.5 \lambda$. Figures 5; tables 1;
references 4:   3 Russian, 1 Western.
[328-6415]

1

ANALYZING AND OPTIMIZING PRINTED-CIRCUIT VIBRATOR RADIATORS FOR ANTENNA ARRAY
WITH DIELECTRIC LAYERS

GRINEV, A. Yu., IL'INSKIY, A. S. and KOTOV, Yu. V.

[Abstract] The basic characteristics of a printed-circuit vibrator radiator in
a periodic rectangular or triangular antenna array are determined on the basis
of a rigorous solution to the boundary-value problem for an integral equation
of the first kind describing the current density distribution. These character-
istics, namely the partial radiation pattern, the input impedance and the ampli-
tude-phase distribution of the electric current are calculated for a thin
vibrator with a Floquet channel above and below. The algorithm of a numerical
solution has been programmed in the FORTRAN language for a BESM-6 computer. As
a test, the thus calculated theoretical impedance characteristics of a plane

half-wave vibrator without dielectric layers above an ideally conducting surface
are compared with experimentally determined ones and the agreement is found to
be close within 2%. The results indicate that this method is suitable not
only for analyzing the performance of but also for optimizing the design of such
radiators. Figures 5; references 8: 6 Russian, 2 Western.
[336-2415]

OPTICAL PROCESSING OF WIDE-BAND SIGNALS OF ANTENNA ARRAY WITH STORAGE TIME
INCREASE

SHMAREV, Ye. K. and KOLESNICHENKO, A. F.

[Abstract] Use of coherent optical devices (COD) for processing signals
received by antenna arrays (AA) represents a promising form of realization of
a parallel scanning of space and a high rate of data processing. Especially
effective are COD for processing wide-band signal from multielement AA, when
the information capacity of the processable field substantially increases.
However, with use of an optical spectroanalyzer with the functions of forming
the directional diagram, in which the input signal from each element of the AA
is registered in separate rows of the input field, the information capacity of
the COD is not always used efficiently. The present work considers the possi-
bility of increasing the information content of the processor with respect to
the time coordinate by means of compression of information with respect to
coordinate y. As a result of this, the storage time of the signal is increased,
which in turn leads to an increase of resoltuion of frequency and an improvement
of the signal-to-noise ratio. The approach considered is a generalization of
the method of optical spectral analysis with high resolution presented in the
literature for the case of space-time processing of the signals of an AA.
Figures 3; references 4: 2 Russian, 2 Western (1 in translation).
[339-6415]

12

TWO-FREQUENCY WAVEGUIDE-DIPOLE OF COMBINED PHASED ANTENNA ARRAY

PONOMAREV, L. I. and SOLOV'YEV, Ye. V.

[Abstract] Combination of different frequency phased antenna arrays (PAA) in
the framework of one or overlapping apertures makes it possible significantly
to expand their functional possibilities and to solve the problem of minimizing
the dimensions occupied by some antennas. A drawing is presented of a combina-
tion scheme which consists of a higher frequency (HF) PAA and, located at a
distance h before it, a lower-frequency (LF) PAA which has the same or a higher
aperture than in the HF PAA. The radiators of the LF PAA are dipoles; to a
considerable degree the radiators of the HF PAA can be arbitrary. The present
paper investigates the principal characteristics of the directivity of a wave-
guide PAA with the above construction. With certain assumptions taken into
account, the problem of determining the maximum distortions introduced by the
LF array into the characteristics of the HF array reduces to a study of the
effect of a periodic array of conductors on the HF PAA, located behind it, with
a known distribution of the field in the axis y' aperture. It is shown that
the initial amplitude distribution in the HF PAA aperture weakly influences the
magnitude of the distortions introduced by the LF PAA into the characteristics
of the HF PAA. An analysis of the radiation pattern shows that the effect of
the LF array leads to a decrease of the level of the principal lobes, and to
the appearance of additional side lobes in the directions θ_p. In spite of a
series of significant assumptions made during their derivation, the approximate
relations obtained for analysis of the distortions introduced by the LF dipoles
of the PAA into the characteristics of HF PAA agree well (with a precision on
the order of 10%) with experimental data obtained on models, even with a ratio
of the operating frequencies of approximately 2.5-3. Figures 6; references 7:
5 Russian, 2 Western.
[331-6415]

WEAKLY-DIRECTIONAL ANTENNA WITH FOCUSING OF FIELD IN APERTURE

MARTSAFEY, V. V., TSALIMOV, G. F. and TSALIMOV, P. F.

[Abstract] At present, interest is shown in the construction of antennas with
weakly-directional radiation in the leading half-space and with considerable
suppression of radiation backwards. The authors consider an antenna, which

although not optimally excited, operates efficiently and is distinguished
by its relative simplicity. The basic concept of such antennas consists in
irradiation of the aperture of a convex screen by a focused field. Excitation
of the aperture in such an antenna by a focused field makes it possible to
attenuate the radiation in the rear half space. Among various focusing mechanisms,
the authors chose focusing with the aid of a guiding system, which assures co-
phasal summation of waves running to the aperture from different sides. A two-
dimensional model of such an antenna is shown. It represents two ideally con-
ducting coaxial cylinders, the aperture in one of them excited by converging
waves produced by a filamentary source. The model is analyzed by the Fel'd
method (RADIOTEKHNIKA I ELEKTRONIKA, 1973. Vol 18, No 9, p 1785). Figures 5;
references: 4 Russian.
[328-6415]

CERTAIN ASPECTS OF COMPUTER HARD AND SOFT
WARE: CONTROL AUTOMATION, TELEMECHANICS,
TELEMETERING, MACHINE DESIGNING AND PLANNING

APPLYING METHODS OF MATHEMATICAL STATISTICS TO ACCURACY ANALYSIS OF AIRBORNE
AUTOMATIC CONTROL SYSTEMS

SINITSYN, B. S., doctor of technical sciences, BELOGORODSKIY, S. L., candidate
of technical sciences, ZELENKOV, A. A., candidate of technical sciences, and
MIROSHNICHENKO, O. G., engineer

[Abstract] Airborne automatic landing control systems function not so much in
response to deviations of the aircraft beyond the permissible range as in re-
sponse to the probability of such deviations or its reciprocal. The parameter
characterizing the accuracy of these systems is the probability of finding the
random vector which characterizes the deviations of the aircraft from the pre-
scribed trajectory within the permissible space of possible states. Estimation
of this accuracy involves determination of the probability of successful landing,
determination of the limiting values (boundaries) of the permissible space,
determination of the necessary sample size and design of the experiment. One
can solve the problem either by assuming a constant probability and seeking the
confidence interval which covers it at a given confidence coefficient or by
assuming fixed observations and seeking a confidence coefficient of the fiducial
kind for the probability values within the estimation interval. There are two
distribution-free methods of nonparametric estimation avilable: frequency
estimation entirely invariable with respect to vector distributions and non-
parametric tolerance intervals, the latter method limited to the class of all
continuous distributions. Parametric methods of estimation inclu^{de} ~onfidence-
interval estimation and parametric tolerance intervals. An accurs , analysis
can also be based on testing of hypotheses. Here testing the hypothesis about
the distribution parameters (m, σ^2) is considered, with the level of the signi-
ficance criterion established for a given fixed sample size, typically using the
Student's t-test or by a sequential procedure applied here to testing the hy-
pothesis about the probability parameter. Figures 6; references 25: 10 Russian,
15 Western (all in translation).
[371-2415]

CALCULATING TRANSIENTS IN D.C. TRANSMISSIONS AND INSERTS WITH AID OF
DIGITAL COMPUTER

ALLILUYEV, ALEKSEY ANATOLYEVICH, candidate of technical sciences, senior
instructor, Novocherkassk Polytechnical Institute; and SHINKARENKO, GLEB
VASIL'YEVICH, candidate of technical sciences, head of laboratory, PEO
[Planning and Economics Department] of "Donbassenergo"

[Abstract] An algorithm has been constructed for numerical simulation of
transients in d.c. transmissions and inserts on a digital computer. It has
been, furthermore, specially programmed to cover normal switching of recti-
fiers as well as various faults. For maximum economy of machine time, a
rectifier or inverter in a d.c. transmission is described by a single differen-
tial equation to which the fundamental system of equations (for individual
diodes on constant-structure time intervals) has been reduced. The three
kinds of faults included in the program, with appropriate adjustments in the
equation are failure of a rectifier to fire and omission of pulses in the
rectifier control circuit, both conditions resulting in an alternation of
normal and abnormal switching, and two-phasing of a 6-phase or 12-phase in-
verter. Calculations made on an M4030 computer for the d.c. transmissions in
the Volgograd-Donnbass line, taking into account current regulation and minimum-
current regulation, agree sufficiently closely with oscillograms and other ex-
perimental data. The results indicate how the sensitivity of fault protection
in such systems must be checked, namely with the d.c. transmission operating
in the single-bridge mode, with the maximum equivalent emf on the rectifier
side and with the minimum prefault rectified current. Figures 5; tables 4;
references: 5 Russian.
[366-2415]

IMPACT OF SENSOR NOISE IN EXTREMUM CORRELATION SYSTEMS

BURDZEYKO, B. P. and NOSOV, O. G.

[Abstract] The properties of the correlation function of one or more arguments
are used in extremum control systems to achieve a maximum of the function when
the values of the arguments are zero. This paper analyzes the impact of

transducer noise on derivative calculating extremal correlation systems, the advantages of which are caused by the fact that the derivative of the correlation function when t = 0 has a considerable slope and the sign changes so that the determination of the correlation function maximum is replaced by the measurement of the zero value of the quantity being controlled. The technique of finding the zero of the derivative of this function, besides being extremely sensitive, has the merit that the amplitude of the input signal and amplitude fluctuations do not have any influence on the measurements. Expressions are derived which define the displacement of measurement values caused by noise. This shift is plotted as a function of the signal-to-noise ratio in a television extremum correlation system intended for automating the assembly of integrated circuits. The proposed technique makes it possible to estimate the impact of noise in the sensors of automated control systems with a precision sufficient for practical purposes. Figures 3; references: 5 Russian.
[334-8225]

SYNTHESIZING FOLLOW-UP SYSTEMS OF INCREASED PRECISION

MAMEDOV, R. Yu.

[Abstract] At present dynamic synthesis of follow-up systems is primarily conducted by the method of logarithmic frequency characteristics (LFC). Regardless of its simplicity and clearness, this system nevertheless has certain shortcomings. In particular, choice of the transfer constant of a system in an opened state is not connected with a choice of the desired LFC system; the required form of the LFC correcting device, which is determined as the difference of the desired and reference LFC, is often only implemented approximately. This causes a divergence of the qualitative indices of the follow-up system from that desired in accordance with the technical assignments. The method of dynamic synthesis of a system which is discussed in the present paper is quite simple and makes it possible with a small expenditure of time to determine the parameters of the correcting units. A block diagram of the correcting system is presented, as well as the amplitude-frequency characteristics of the system. With the object of confirming certain of the results obtained, a transient process was constructed and is presented. The paper was recommended by the Department (Kafedra) of Automatics and Telemechanics, Penza Polytechnical Institute. Figures 3; references: 1 Russian.
[348-6415]

CORRECTING COORDINATED ERRORS IN SKAN-2 DEVICE

OBIDIN, Yu. V. and POTASHNIKOV, A. K., Novosibirsk

[Abstract] The "Zenit-2" photogrammetric automatic device was developed at the Institute of Automatics and Electrometry (IA and E), into the composition of which the SKAN-2 scanning device enters, based on a cathode-ray tube with electromagnetic control of the position of a light spot, intended for entry into a computer of the coordinates and optical densities of photographic images. It is known from the literature that distortion of an electrooptical system, distortion of the projection optics, errors of the generators of deflection currents, instability of supply voltages, and some other destabilizing factors break down the conformity between the specified and real coordinates of the light spot in the plane of the carriers of the photo effect. Naturally, during development and exploitation of precision scanning systems, the problem arises of compensation for the geometrical and scale distortions of the raster, and the process of measuring the coordinates with the greatest possible accuracy, or in advance with a specified precision. The present paper describes a system of compensation for the systematic coordinate error of a SKAN-2 device, and a method of calibration is presented. As a result of the calibration, errors throughout the field of the scanning system did not exceed 1.5 quanta (0.03%). In the process, the correction system not only removed errors of the scanning device, but also established a precise conformity of the scale and parallelism of the electromechanical and electrooptical system of coordinates. Figures 3; references: 1 Russian.
[319-6415]

TWO-CHANNEL ANALOGUE STORAGE DEVICE FOR SLOWLY VARYING SIGNALS

PONKRATOV, Ye. I., Donetsk State University

[Abstract] An experimental investigation of alternation is based on the method of conditional statistical averaging, using separation of the process into the time at intervals which pertain to different types of trends. During this, for the solution of certain problems, processing of a low-frequency signal in current time is required. However calculation of the characteristics on a computer in a real time scale is difficult or impossible. The author proposes the circuit of an analogue storage device (ASD) which makes it possible to measure the zone

statistical characteristics of alternation in current time. The ASD consists
of two identical channels for recording, storage, information read-out and a
control circuit based on microcircuits. Identical transistor switches control
two field-effect transistors in each of the two channels. The circuit of the ASD
is shown and discussed. The change of the storage voltage at the output of the
ASD amounted to $2 \div 3$ mV/min. The time of information storage was ten minutes
with an error of $\sim 1\%$. The temperature drift of the storage voltages was
$\leqslant 0.1$ mV/°C. The range of stored voltages was ± 5 V. The time for recording
information was 0.1 second with a transfer constant of the channels equal to 1.
The amplitude value of the signal was $+(2 \div 5)$V. The device was used in equip-
ment for investigation of the statistics of alternating flow, and also for
measurement of the extreme values and signals in a system for automatic search
of the parameters of classifying. Figures 2; references 3: 2 Russian,
1 Western.
[320-6415]

CERTAIN ASPECTS OF PHOTOGRAPHY,
MOTION PICTURES AND TELEVISION

INVESTIGATING RESOLUTION OF DISSECTORS USING LASER INTERFERENCE RESOLUTION
TESTER

DALINENKO, N. K., KOROTUN, V. P., OSIPOV, Yu. V., POPOV, V. N. and
SHUSTERMAN, L. P.

[Abstract] The paper is concerned with the development of a laser interference
resolution tester (LIRT) for comparatively low space frequencies: as far as
300-400 lines/mm (150-200 periods of interference raster). A LIRT for investi-
gation of the resolution of TV dissectors was assembled. A block diagram and a
discussion of its operating principles are presented. The results of investiga-
tions of the device demonstrate the advantages of the interference method over
the projection method. The proposed LIRT can be used for investigation of
various types of television transmission devices. The paper was recommended
by the Physics Department (Kafedra) of the Leningrad Electrical Engineer
Institution imeni V. I. Ul'yanov (Lenin). Figures 2; references: 4 Russian.
[348-6415]

DIGITAL ADJUSTABLE TWO-SIDED THRESHOLD SELECTOR

GRAKOV, A. I.

[Abstract] A digital adjustable two-sided threshold selector can be used in
devices of discrete automatics where the introduction and adjustment of a highly-
precise, stable threshold of sensitivity are required, in particular, for adjust-
able limitations of the noise level of the video channel of the dissector tube
of a digital television coordinator. A time diagram and the principal circuit

of the proposed device are presented and explained. The device can be constructed on the basis of potential microcircuits of any series, both of positive (133, 134, 155,217 and others) and negative logics. For an experimental examination, the device was assembled on the basis of microcircuits of series 133 and 134; the limiting frequency of pulses, entering into the unit amounted to 1 MHz; the scanning range = 256 pulses; the magnitude of the threshold $\Delta = 0 \div 15$ pulses; the amplitude of the pulses is $2.4 \div 5.0$ V. It should be noted that in principle the range of adjustment of the threshold is unlimited. Figures 2; references: 2 Russian.
[320-6415]

POWER NANOSECOND VIDEO AMPLIFIER FOR CIRCUIT WITH COMBINED VOLTAGE

D'YACHKO, A. N. and BABAK, L. I., Tomsk Institute of Automated Control Systems and Radio Electronics

[Abstract] The circuit of a power nanosecond transistorized video amplifier of unipolar pulse signals is described, which because of the use of contemporary microwave transistors and high-frequency compensation, assured a rise time of $\sim$ 3 nanosec with maximum amplitude of the output pulse voltage of 140 V. A formula is presented for an engineering calculation of the elements of the amplifier. The equivalent circuit of an amplifier with combined voltage is shown as well as that of the principal circuit of the power nanosecond video amplifier. The technical characteristics of this amplifier are as follows: amplification factor, 350; dynamic range of output pulse voltage at a 75 ohm load (with nonlinearity of the amplification factor $\leq$ 13%), $10 \div 140$ V; rise time of transient characteristic < 3 nanosecond; overshoot $\leq$ 3%; decrease of peak of a pulse with a duration of 500 nanosec not more than 2%; voltage standing-wave ratio of input < 2 with resistance of regenerator of 75 ohm; polarity of input and output pulses, negative; voltage of power supply, 60 V; current consumption, 0.6A; relative pulse duration $\geq$ 10; dimensions, 170 x 117 x 90 mm^3; mass 850 gram. Figures 2; references: 5 Russian
[320-6415]

INTEGRATED SEMICONDUCTOR MICROCIRCUITS FOR VERTICAL SWEEP

SKLYAR, V. A. and YAKOVLEV, S. B., Moscow Electrotechnical Institute of Communications

[Abstract] Vertical sweep generators built on integrated microcircuits with the deflection coils at the output of the last stage operate at low frequencies and require a control voltage with a sawtooth-pulse waveform, the magnitude of the pulse component depending directly on the time constant of the deflection coil. Modern semiconductor integrated-circuit technology has made it feasible to produce heavy-duty transistors with a collector-emitter breakdown voltage as high as 60 V for the output stage of these sweep generators. The low operating frequency and voltage pulses smaller than in the horizontal sweep make it easier to minimize the heating and optimize the cooling. The series K174GL1 and K174GL1A integrated microcircuits which the Soviet electronic industry now manufactures combine low-power and high-power components of the sweep generator intended for black-and-white as well as color television receivers. The basic components of such a sweep generator are a synchronization circuit, a master oscillator, a sawtooth voltage generator, a buffer stage, a preamplifier, a power amplifier, a shaping circuit and a voltage stabilizer. In addition, a K174GL1A microcircuit incldues also a return-stroke pulse forming stage. Both series can deliver a load current of 1.1 A with maximum 8% nonlinear distortion and are tunable over the 28-66 Hz frequency range, drawing 130-180 mA from a 24+0.24 V supply. Their three outstanding features are a high frequency stability in the oscillator mode of operation and during forced synchronization, that they generate a linear deflection current in any deflection system with no sensitivity to the variance of all other circuit components and parameters, and that they do not overheat even at high ambient temperatures. They are built into a plastic case rated for 85°C maximum operating temperature, with 12 lead terminals and a copper heat sink. Both K174GL1 and K174GL1A series are compatible with the Soviet-made series K174AF1 microcircuits for horizontal sweep generators. Figures 5; tables 2.
[362-2415]

PIGMENTED SCREENS FOR COLOR CATHODE-RAY TUBES

IMSHENETSKIY, V. V., MALKIYEL', B. S. and MIZYUK, M. G.

[Abstract] For decreasing the reflection coefficient of the luminophor coating on the glass screen of color cathode-ray tubes, it is technologically easier to

coat the screen with a pigmented luminophor consisting of grains covered with a thin film of pigment than to deposit an optical filter between the coating and the glass. Although the pigmented layer absorbs some energy of the electron beam and thus attenuates the radiation emitted by the luminophor, it increases the contrast of the reproduced image, especially when the glass underneath has a high transmission coefficient. There are two methods of pigmenting available, namely preprocessing the luminophor in a pigment solution with subsequent baking at a high temperature or injecting the pigment into the luminophor suspension during the screen fabrication process. The latter method was used in an experimental production of a model 25LK2Ts kinescope. A fine-disperse solution of an ultramarine pigment (sodium sulfoaluminosilicate $Na_8Al_6Si_6S_4O_{24}$) in ethyl alcohol (1/kg/1) was added to the luminophor suspension. This pigment had been selected because of its high transmission coefficient in the pass band and high absorption coefficient on both sides of that band, also because of its stability under electron bombardment and negligible diffusion into the luminophor grains. Furthermore, pigmenting a blue luminophor is most expedient: it contributes only 11% to the intensity of white glow and a slight loss of intensity here would not be as significant as in the case of a red luminophor (contributing 30%) and, especially, a green luminophor (contributing 59%). The reflection spectra of the luminophor with various pigment concentrations ranging from pure luminophor to pure pigment, as well as the dependence of the resultant reflection coefficient and the screen glow intensity on the pigment concentration, measured with an SF-114 spectrophotometer, reveal that adding 60 ml/1 of this pigment decreases the reflection coefficient in the 600 nm wavelength band from 0.75 to 0.40 with only a 1.5-5% accompanying decrease of the glow intensity. Increasing the pigment concentration further decreases the glow intensity appreciably without significantly decreasing the reflection coefficient further ($\rho = 0.28$ for pure ultramarine). Figures 5; references 7: 2 Russian, 5 Western.
[362-2415]

TELEVISION METHODS OF LOW-FREQUENCY SPATIAL IMAGE PROCESSING

NOVOSADOV, V. N. and KHITROVO, N. G.

[Abstract] Low-frequency spatial processing makes a television image steadier and thus improves either the interference immunity of image transmission or the contrast sensitivity of the television system. So far the best method for such processing appears to be electrical control of the television transmitter tube, which combines the advantages of electrical and electron-optical processing. This requires the use of an electrical low-frequency space filter which produces a control signal in real time and feeds it to the vidicon cathode. Defocusing and changes in the beam current are prevented by dynamic adjustment of the potentials at the other vidicon electrodes. Such a processing system with

automatic gain control in the video channel ensuring a threshold contrast of
1% includes, besides additive local correction of the image brightness, also
multiplicative adaptation of the light-signal characteristic (slope of the
light-signal curve) to ensure an adequate contrast in the dark regions of the
image. Additive and multiplicative correction with one-dimensional shaping of
the signal envelope by half-sums and half-differences for white and for black
respectively has already been proposed. Here two-dimensional smoothing of
samples from individual image segments, by recording the peak levels of the video
signal and storing them in a memory for subsequent computation during scanning
of the next image field, is proposed as means of isotropic shaping of signal
envelopes. The basic structure of such a correction device and its performance
are described, with the image, for illustration, subdivided into 3 x 4 = 12
segments. Various recording errors are reduced by a proper definition of the
sample level and by the use of diode circuits, which have a finite-slope re-
cording characteristic. There still remain errors caused by the spatial dis-
creteness of an image. These errors can be reduced by defining the sample
level relative not to the absolute zero potential but to a voltage which varies
within each image segment, namely the voltage obtained by subtracting samples
from the correction signal. Figures 5; references 9: 6 Russian, 3 Western
(one in translation).
[362-2415]

ESTIMATING FLUCTUATION INTERFERENCE IN FULL COLOR TELEVISION SIGNAL

DVORKOVICH, V. P.

[Abstract] A new method of estimating the interference level in the full color
signal has been developed which is particularly applicable to digital television.
It is based on stroboscopic transformation of the image signal and on the corre-
lation between signal and interference transforms. The equipment consists of a
weighting filter, a strobe with a pulse shaper, a band filter, a nonlinear con-
verter and an integrator. The principle of the method is explained by first
considering the signal of a static image without color subcarriers, then extrac-
tion of the interference spectrum from the full signal spectrum and conversion
of the signal of a moving image. The optimum filter for linear filtration of
fluctuation interference is synthesized, nonlinear processing of a signal being
possible before or after filtration. The algorithm of digital processing
of fluctuation interference for a determination of the signal-to-noise ratio
according to this method covers the range up to 40 dB for an unweighted inter-
ference and up to 55 dB for a weighted interference, with a methodological error
within 1 dB. Figures 6; tables 1; references: 12 Russian.
[360-2415]

STEREOTELEVISION SYSTEM BASED ON LIGHT-VALVE SPECTACLES

MALKOV, E. M., PETERIMOV, S. V., STRONIN, V. G. and SHOSHIN, V. M.

[Abstract] A set of spectacles for a stereoscopic television system is described
in which a liquid-crystal cell controlled by synchronizing signals acts as a
light valve. On the transmitter side of such a system there are two cameras,
a generator of synchronizing signals, two encoders, a channel switch, and a
transmitter of synchronizing signals. On the receiver side there are a receiver,
a channel selector and spectacles controlled by either meander or sine-wave
signals. Each liquid-crystal cell here is triggered by a low-frequency (50-
1000 Hz) voltage and blocked by a high-frequency (50-100 kHz) voltage of a 70-
90 V amplitude, switching within 0.5-1.5 ms from translucent to opaque state or
vice-versa. This time is comparable with the duration of an interlacing blank.
A liquid-crystal cell for this application comprises a 10-20 micrometer thick
layer of a viscoelastic mixture with a positive dielectric anisotropy which
reverses sign within the 10-15 kHz frequency range, hermetically enclosed between
two glass wafers. Such sets of spectacles, with appropriate components of the
television transmitter-receiver system, have been developed in two versions:
one for black-and-white and one for color. Figures 2; references: 4 Russian.
[362-2415]

CERTAIN ASPECTS OF RADIOASTRONOMY,
SATELLITES AND SPACE VEHICLES

STUDYING GROUND OF PLANETS BY ANTENNA IMPEDANCE MEASUREMENT

BADER, V. A., PAVEL'YEV, A. G., NOVICHIKHIN, Ye. P. and SHVACHKIN, K. M.

[Abstract] The feasibility of studying the ground of planets by the method of
antenna impedance measurements is analyzed, this method requiring installation
of movable equipment on the planet surface. In the theoretical part of this
analysis relations are established which describe the dependence of the antenna
impedance on the properties of the ground and on its stratification. Three
problems are involved here: determining the current distribution in the antenna,
determining the fields produced by this current distribution in the ambient
medium, and determining the reaction of these fields (including the fields
reflected by boundaries between media with different properties) on the antenna
current. In the experimental part of this analysis are evaluated the results
of measurements made with a horizontal dipole antenna, pertaining to the frequency
characteristics of its resistance and capacitance as well as the dependence of
its resistance on the radiation wavelength, on its relative distance from the
ground and on the electrical conductivity of the latter. It thus appears that
antenna impedance measurements can reveal a great deal about a planet's ground.
It is advisable to extend, for this purpose, the frequency range of measurements
beyond very low frequencies. Figures 5; references 12: 8 Russian, 4 Western.
[336-1425]

CIRCUIT THEORY AND PRACTICE

STATIC AND DYNAMIC CHARACTERISTICS OF 521 SA2 COMPARATOR INTEGRATED CIRCUIT

DASHKEVICH, V. M.

[Abstract] Because the specification data sheet on the 521 SA2 voltage comparator
IC does not have information needed for its applications in high-speed devices
for which it is suitable, its static performance and transient response in the
nanosecond range were studied experimentally. The comparator is designed around
a two-stage differential amplifier with an asymmetrical output loaded into a
specifically compensated output network. A schematic of the IC is drawn and its
operation is discussed in some detail. Static tests for a reference voltage
of 0 showed nearly identical maximum and minimum output signal voltages for the
two IC samples tested: 3.3 to 3.4 V max and -0.5 to -0.55 V min output with a
maximum possible voltage gain of about 1,540 and a sensitivity of about 2 mV.
The transient response of the IC is illustrated graphically showing the output
voltage as a function of time (in nsec) for various bias levels. Figures 6;
references: 4 Russian.
[334-8225]

STATISTICAL CHARACTERISTICS OF SYNCHRONIZATION BREAK-DOWN IN ANALOG SYSTEM OF
SECOND-ORDER AUTOMATIC PHASE CONTROL

MIRONOV, M. A. and BELOUSOVA, V. S.

[Abstract] The authors consider methods of calculating the statistical charac-
teristics of a break-down of synchronization in the case where the boundary
conditions of a boundary value problem are assigned part of the boundary of

the synchronization domain. Use of the algorithms obtained for a numerical solution is illustrated, using as an example an analysis of synchronization break-down in an automatic phase control system of the second order with sinusoidal characteristics of a discriminator and an integrating filter in a feedback circuit. The results obtained make it possible, in particular, to evaluate the precision of calculating the average time up to break-down of synchronization by approximate methods and to determine the range of the initial values of the coordinates of a system with which a given quality of synchronization is assured. It is concluded that the method of solution of a boundary value problem makes it possible to obtain the statistical characteristics of a synchronization break-down in an automatic phase control of the second order with arbitrary characteristics of the phase detector as well as to investigate other phenomenon connected with the first output of the phase trajectory of a system beyond the limits of the given domain. Figures 7; references: 12 Russian.
[328-6415]

FREQUENCY SYNTHESIZER BASED ON PULSE PHASE LOCKED LOOP AND DIVIDER WITH FRACTIONALLY VARIABLE DIVISION FACTOR

ANICHKOVA, L. K., GUREVICH, I. N. and NIKITIN, Yu. A.

[Abstract] A periodic reference frequency pulse train is fed to the input of a pulse phase detector which in turn drives a series connected low-pass filter and harmonic generator. This series configuration is looped by feedback between the output of the harmonic generator and the second input of the detector, where the feedback loop contains a frequency divider with a fractionally variable division factor. The analysis assumes that the pulse-phase detector is an RS flip-flop so that for the synchronous steady-state mode, its output is a train of pulse width modulated pulses. Analytical expressions are derived for this configuration which make it possible to calculate the level of the discrete interference components for any working algorithm of the frequency divider. The more difficult problem of synthesizing an optimal algorithm for the divider is analyzed in some detail to derive an algorithm where the interference level in the output of the PLL synthesizer is minimized. The formulas were checked experimentally with a frequency synthesizer operating with an output frequency range of 10 to 11 MHz with a step of 1 KHz. The comparison frequency in the pulse-phase detector was 10 KHz; the capture bandwidth of the PLL was 0.5 MHz and a series RC network with a cutoff frequency of 500 Hz and twin-T RC bridge tuned to the 10 KHz comparison frequency (a rejection filter) was used as the low-pass filter. In a 2 to 5 KHz frequency range, the attenuation of the rejection filter is equivalent to the attenuation of the integrating RC network. The sensitivity of the measurement equipment was -90 dB relative to the fundamental signal. The divergence

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between the experimental and design data falls within the limits of equipment error. It is noted that no algorithm exists which makes it possible in the variable division factor divider with a single decade fraction simultaneously to suppress the first and even harmonics of the frequency step. The calculated and actual suppression of the various harmonics are summarized in a tabular comparison. Figures 1; references 3: 2 Russian, 1 Western.
[334-8225]

SYNTHESIZING COMBINATIONAL CIRCUITS WITH MULTIPLEXERS

MOSKVICHEV, V. A.

[Abstract] A method of synthesizing combinational logic circuits with multiplexers is shown which makes use of Veitch diagrams. Generally a function of n variables is realizable with one multiplexer for 2^n channels which has n address inputs, or with one multiplexer for 2^{n-1} channels which has n-1 address inputs, after the function has been expanded in one variable and the functions of this variable have been brought to the multiplexer data inputs. Here the function of n variables is expanded in k variables and the resulting set of complementary functions of the k variables are brought to the data inputs of a 2^{n-k}-channel multiplexer. The synthesis proceeds through construction of a Veitch diagram excluding the k variables, there existing $n!/k!(n-k)!$ variants of expansion and for each combination of selected k variables only one variant of joining squares in the diagram. Use is made of the function table and the groups of 2^k squares are numbered in the order of increasing number of joined squares. The method is demonstrated on a function of five variables and its realization, after expansion in two variables, with a $2^3 = 8$-channel multiplexer having 3 address inputs. Figures 4; tables 1; references: 2 Russian.
[360-2415]

COMMUNICATIONS, COMMUNICATION EQUIPMENT, RECEIVERS
AND TRANSMITTERS, NETWORKS, RADIO PHYSICS, DATA
TRANSMISSION AND PROCESSING, INFORMATION THEORY

TELEPHONE CABLES WITH ALUMINUM-COPPER CONDUCTORS

PARFENOV, Yu. A., RYSIN, L. G. and SHERMAN, N. L.

[Abstract] Marks TSPZP6 and TSPZPB6 low-pair cables with diameters 0.5 mm with
the number of pairs 5, 10, and 20; and 0.9 mm with the number of pairs 5 and
10, respectively, were developed, tested and implemented for rural subscriber's
networks. Both cables have bimetal (aluminum-copper) conductors with polyethylene
insulation of the conductors, with water-repelling filling of the core to prevent
penetration of moisture, and an aluminum shield. However, the TSPZPB6 is finished
with a polyethylene sheath, and the TSPZPB6 is armored by one steel band and
placed in a polyethylene protective hose. The internal arrangement of the cables
is shown, and the dimensions of their elements are listed in two tables. It is
possible to say these cables in the ground for telephone canalization or to
suspend them on the supports of overhead communication lines in various climatic
zones. The electrical characteristics of the cables are listed in a table.
The cables were tested at various places in 1977-1978. Mass output of the cables
is contemplated in 1981. Figures 1; tables 3.
[355-6415]

FREQUENCY STABILITY REQUIREMENTS OF LOCAL READOUT-TIMING GENERATOR FOR
START-STOP RECEPTION OF DISCRETE MESSAGES

GLOBUS, I. A.

[Abstract] Cadence synchronization during start-stop reception of discrete
messages is effected by a local oscillator, with a single triggering at the
instant of detection of the start sync-signal. Any frequency instability of

this oscillator affects the reliability of reception in the presence of inter-
ference only, being otherwise either imperceptible or easily compensated by
proper choice of the threshold level. Here the maximum permissible frequency
instability of such an oscillator is determined and its dependence on both the
signal-to-noise ratio and the number of digits in a word is established, with
the probability of correct detection (demodulation and decoding) as the governing
criterion. In the case of an additive Gaussian channel with noncoherent recep-
tion and a maximum-likelihood or logical-discrimination demodulator it is found
to be inversely proportional to the relative energy in a signal element, the
number of digits in a word, and the corrective power of the code. It also
decreases with increasing carrier base and increasing base of the signal
alphabet. References: 5 Russian.
[360-2415]

NEW METHOD OF MEASURING ATTENDANT PARASITIC AMPLITUDE MODULATION IN FM
TRANSMITTERS AND OSCILLATORS

ZEN'KOVICH, A. V. and TIPASHOV, V. I.

[Abstract] A new method has been developed for measuring the attendant parasitic
amplitude modulation in FM devices which is based on compensating the frequency
modulation and subsequently measuring the degree of amplitude modulation. The
method eliminates the need for a detector with a linear amplitude characteristic
and almost completely eliminates the effect of channel nonideality with the re-
sulting limitation on the resolving power. The instrument includes an auxiliary
transmitter or oscillator analogous to the tested one, with an amplifier, a
mixer and, if necessary, an internal instrument heterodyne. Differences between
the two transmitters or oscillators are accounted for in the error analysis.
Measurements by this method performed on a modulating GZ-107 audio oscillator
with an instrument consisting of standard components (G4-107 auxiliary FM
oscillator, UZ-26 wideband amplifier, and SKZ-40 diode-type mixer in the modula-
tion meter) indicate a high resolution and a satisfactory accuracy. Figures 5;
references: 6 Russian.
[360-2415]

INVESTIGATION OF KEY ANODE MODULATORS WITH SERIES AND PARALLEL POWER
SUPPLY OF HIGH-FREQUENCY OSCILLATOR

ARTYM, A. D., KOZIN, Ye. V., NIKOLAYEV, V. V., RYABUSHEV, V. B., SIDEL'NIK, B. V.
and SOKOLOV, E, P.

[Abstract] The paper conducts a comparative experimental investigation of the
energy and qualitative indices of Class D anode modulating devices, construc-
ted in accordance with circuits for series and parallel power supply of a high-
frequency qenerator (HFG). The following items are considered: 1) Overall
circuit of key modulator with series power supply of a HFG; 2) Overall circuit
of modulators with parallel power supply through a HFG; 3) Principal circuit of
model of key modulating device with series feed of HFG; and 4) Principal circuit
of model of key modulating devices with parallel power supply of HFG. The com-
parative results of the experimental investigation of both modulators are
examined, and it is concluded that the mass-size and qualitative indices of
both modulators (series and parallel feed) are approximately equivalent. The
efficiency of the modulators fulfilled by a parallel circuit is higher by 5-6%
than the modulator with a series circuit, even with the doubled voltaged of the
power supply of the latter. The operational and structural qualities of the
modulator with parallel power supply of a HFG is undoubtedly better. Consequently,
use of such a modulator in contemporary high-power radio broadcasting transmitters
can be considered as preferable. Figures 6; tables 5; references 8: 6 Russian,
2 Western.
[337-6415]

ATTENUATION EQUALIZATION FOR REFLECTIVE MICROWAVE PHASE KEYERS

SHEYNKMAN, V. G.

[Abstract] The frequently stringent requirements placed on the stability of the
output microwave power of phase keyers necessitates the equalization of keyer
attenuation. This can be accomplished in two ways: boosting the low attenuation
by means of special resistors, or by simultaneously bringing the higher and
lower attenuation closer to some average value by using additional mismatching
reactances. Analytical expressions are derived for these two cases to design
the appropriate resistive and reactive equalizers for such keyers with an
arbitrary attenuation in each of its phase states. A merit of resistive

equalization is the capability of equalizing nonuniformities in the keyer attenuation. Reactive equalization is difficult with a large initial nonuniformity, since a large reactive conductivity is needed and the keyer becomes difficult to tune while its sensitivity is increased. An advantage of the reactive over the resistive technique is the lesser attenuation of the keyer with the equalizer. A reactive equalizer is simpler to fabricate because there are no resistive components in it, and making the equalizing conductance in the form of a line section simplifies the fine tuning of the equalizers, because this can be accomplished by trimming the length. This paper does not treat wideband equalization; it is assumed that the keyer operates with the equalizer at a single carrier frequency. It is noted that an experimental study of both equalization techniques for a keyer operating in the 5-cm band showed that attenuation equalization is preserved when the carrier frequency is changed in a range of several 10s of megahertz. No sample calculations are adduced. Figures 5; references: 2 Russian.
[334-8225]

UDC 621.391

SIGNAL DETECTION SYSTEM DESIGN WHEN ELIMINATING AMBIGUITY BY MEANS OF NONINFORMATIONAL PARAMETER

RYLOV, V. I. and TEREKHOV, A. L.

[Abstract] An example of a detection system which is invariant with respect to the value of a noninformational parameter is a time synchronizer for a phase-keyed signal at an unknown frequency. After such a signal is multiplied by a copy of its phase envelope, the time position of which matches the time position of the phase envelope at the moment of detection, a sine wave of unknown frequency appears at the output of an ideal multiplier. The entire range of possible signal frequencies can be broken down into N identical frequency channels, the bandwidths of which are matched to the spectral width of the convoluted signal. The influence of the ambiguity in the noninformational parameter on the signal detection characteristic can be reduced by inserting postdetector selection of the channel with the maximum instantaneous envelope value. A receiver containing N bandpass filters matched to the spectrum of the signal being detected over the passband and covering the entire range of frequencies in which a signal can appear is analyzed for the case where the outputs of the filters drive circuitry for selecting the maximum. Then the greatest of the output signals of the N channels is compared to the threshold, chosen in accordance with the Neuman-Pearson criterion. The following are assumed: 1) The interference is additive gaussian white noise; 2) The detector characteristic is $z = y^2$; 3) The form of the amplitude-frequency response of a channel filter is close to rectangular and the channels do not overlap; 4) The signal does not fall on the slopes of the characteristics of adjacent filters;

and 5) The signal in the additive noise mixture can be present in only one channel and has the same probability of appearing in any given channel. Analytical expressions are derived for the detection and false alarm probabilities and illustrated graphically. The detection probability is plotted as a function of the number of channels for a fixed signal-to-noise ratio at the detector input and a fixed false alarm level. The losses increase insignificantly with an increase in the number of channels after a certain number of channels is reached (7 in the case of a false alarm probability of 10^{-3}, a detection probability of 0.9 and losses of 0.5 dB). Figures 4; references: 2 Russian.
[334-8225]

COMPOSITE DISTRIBUTION AND NUMERICAL CHARACTERISTICS OF SIGNALS AT OUTPUTS OF SEVERAL PROCESSORS OF PULSE SIGNAL PACKETS

FEDORCHENKO, V. A.

[Abstract] The problem of determining the composite distribution, or its numerical characteristics, of signals at the outputs of several processors of pulse signal packets is analyzed, such processors performing a triple summation of double integrals of functions defined by weighting factors, fluctuations and mean values of the amplitudes of the input signals. The input signals to all channels (processing stages) are assumed to have a normal distribution with zero mean values and some space-time correlation function, processing in each channels being done independently. The solution to the simultaneous equations for the integrand functions, assuming rectangular frequency characteristics of the filters, yields the characteristic function of intrastage processing: intraperiodic or interperiodic (coherent). Slow fluctuations are considered, with generally $T_j \Delta F_j \neq 1$ (T_j—effective duration of the pulse packet in the j-th processing stage, ΔF_j—effective bandwidth of one filter "comb" in the j-th processing stage). References 10: 6 Russian, 4 Western (two in translation).
[360-2415]

34

SUPPRESSING RESIDUAL SIDE LOBES IN PERIODIC CORRELATION FUNCTIONS FOR QUASI-NOISE
SIGNALS WITH AMPLITUDE MANIPULATION

KLYUYEV, L. L.

[Abstract] Binary and quaternary quasi-noise signals with amplitude manipulation
are considered, a quaternary such signal consisting of two binary ones trans-
mitted at different carrier frequencies. Measurement of the delay of such signals
in a multibeam channel is difficult, because of the presence of residual side
lobes in the periodic autocorrelation functions. Here a method of suppressing
these residual side lobes is demonstrated for the specific case of 2-level
periodic autocorrelation functions. Complete suppression is shown to be possible
by selection of the proper reference signal from the class of phase-manipulated
quasi-noise sequences, namely such a sequence with a period $N = 2^k$ that the
periodic cross-correlation function in the form of a weighted product will satisfy
the appropriate constraining conditions. In terms of the signal-to-noise ratio
at the output of the processing device, the penalty for using this method instead
of matched filtration approaches 3 dB as $k \to \infty$, being larger or smaller than
3 dB for $k < \infty$ in sequences with the number of adjacent "1" symbols smaller than
or equal to the number of "0" symbols or larger than the number of "0" symbols
respectively. References: 5 Russian.
[365-2415]

TRUNCATION ERRORS IN DISCRETE HILBERT TRANSFORMATION OF NARROW-BAND RANDOM
PROCESSES

MORGULEV, S. A., PAVLOVA, T. N. and PAVLOV, A. L.

[Abstract] The discrete Hilbert transformation is used extensively in digital
processing of signals which involves concepts of analytical (Hilbert) signal,
envelope, phase and instantaneous frequency. Its practical realization involves
errors caused by the truncation necessary for ensuring a physical realizability.
Here these truncation errors and their statistical characteristics are analyzed
in the case of a stationary input sequence $x(n)$ formed by readings, with a
$\Delta\tau = \pi/2\omega_0$ discretization step, of a narrow-band random process with a zero mean
value and the autocorrelation function
$$K = \sigma^2 \frac{\sin(\alpha\tau)}{\alpha\tau} \cos \omega_0\tau.$$ The relative dis-

person of the truncation error was calculated as a function of the length of the

pulse characteristic of the Hilbert converter and found to decrease at an increasing rate as the latter increases. Figures 1; references 5: 3 Russian, 2 Western.
[336-2415]

SYNTHESIZING STABLE DETECTORS OF SIGNALS IN NORMAL NOISE BY REGULARIZATION METHOD

BASISTOV, Yu. A.

[Abstract] Measurement and rounding errors as well as nonmeasurable signal and interference parameters, also the finiteness of informative samples, contribute to an a priori indeterminacy in signal detection. Here the problem is stabilized by the A. N. Tikhonov regularization method, namely by finding a regularization operator which will convert the problem of maximum-likelihood estimating an unknown parameter to a well-conditioned problem in the Adamar sense. Algorithms of detector synthesis are constructed, accordingly, for nonrandom signals in random noise and for normal random signals in random noise. The results are found to be comparable with those obtained by the minimax method, the resolvent function of linear minimax detector belonging in the class of regularized functions but with an overvalued regularization parameter. References 9: 6 Russian, 3 Western (one in translation).
[336-2415]

CHOICE OF FILTER PARAMETERS IN LOCAL INTERFERENCE COMPENSATORS

BOZHOK, Yu. D., KRASNYY, L. G. and MAYSTRENKO, S. N.

[Abstract] The authors conduct a comparative analysis of the principal methods of constructing quasi-optimum filters and evaluate the effect of their parameters on the noise sensitivity of compensators of local interference. It is shown that: 1) For signals and interference with relatively equal spectral densities, it is advisable to realize quasi-optimum filters in channels for compensation of local interference in the time region, on the basis of nonrecursive filters on delay lines with weighting factors in the taps. In the process, practically without losses of the noise immunities, the total number of weighting factors in the

compensator can be selected as equal to $N_1 = n(Q + 2)$, where n is the number of elements in the antenna; Q is the expected amount of local interference, and the sampling rate of the voltage in the delay line is two to three times more than with digitization of signals according to the Kotel'nikov theorem. 2) A significant simplification of technical realization and an increase of the efficiency of suppression of the local interference in real conditions of location can be achieved by use of algorithms of compensation of local interference at the outputs of shaped space channels. In the process the total number of weighting factors in such a compensator amounts to $N_2 = (5 \div 7) \ Q \leqslant N$. 3). In the case of a significant irregularity of the spectral density of signals and interference, it is advisable to synthesize quasi-optimum filters in the frequency region on the base of processors of rapid Fourier transformations or other device for narrow-band filtration. In the process, the total number of actual weighting factors in an octave field $N_3 = (14 \div 24) \ Q$. Figures 4; references: 4 Russian. [326-6415]

SEQUENTIAL DETECTION OF CORRELATED SIGNAL APPEARING WITH BACKGROUND NOISE

SHLOMA, A. M. and GOL'FEL'D, G. B.

[Abstract] Sequential detection of a strongly fluctuating signal is considered in the case where such a signal, a correlated normal random process with a zero mean and an unknown dispersion, appears together with an additive normal noise of unknown intensity independent of it. The presence of the signal should be indicated by a change in the correlation characteristics of the readings. The problem reduces to construction of a procedure for testing the hypothesis H_0 that the correlation of readings is caused by noise against the alternative H_1 that the correlation of readings is due to a signal+noise mixture. The problem is solved by sequential testing of hypotheses about the parameters of a one-dimensional autoregression model. With the sample regarded as being approximately stationary, because in practice usually $\sigma^2_{noise} \gg \sigma^2_{signal}$, the procedure is based on using

sample correlation coefficients and Wald thresholds. The procedure is then extended to the multidimensional case such as sequential detection of a strongly fluctuating multifrequency signal appearing under similar conditions.
References 4: 2 Russian, 2 Western (one in translation).
[365-2415]

STRUCTURE OF METER ENABLING POTENTIAL PRECISION

MORGUNOV, A. N.

[Abstract] The words "potential precision" should be understood to mean the precision of evaluation of the parameters of a signal on a background of white Gaussian noise. In order to realize potential precision the structure of the meter must correspond to the algorithm

$$\max_{\lambda} \ln \Lambda = \max_{\lambda} \int u(t, \lambda) \, dt,$$

where Λ is a function of the probability of a parameter which is evaluated and $\lambda = \lambda_0 + \Delta\lambda$. The measurer of the parameter λ_0, which assures potential precision of measurement must realize a number of operations listed in this brief communication. References: 2 Russian.
[326-6415]

ADAPTIVE METHODS OF STABILIZATION OF PROBABILITY OF FALSE ALARM UNDER
CONDITIONS OF EXPONENTIAL TYPE CLUTTER

ABRAMOVICH, Yu. I. and TSYGANOV, O. V.

[Abstract] This brief communication is concerned with the synthesis and investigation of the effectiveness of adaptive threshold devices which solve the problem of stabilizing the probability of false alarm in clutter of an exponential type, both during stationary training sampling and with sampling which contains "drop out" elements. Effective methods are developed for forming of the threshold level, with respect to both stationary samplings and samplings containing "drop out" elements, which for practical purposes, sufficiently assure precision of stabilization of the probability of false alarm with any degree of a priori indeterminancy concerning the area of possible distribution of exponential type clutter. Figures 2; references 9: 5 Russian, 4 Western (1 in translation).
[339-6415]

USING INTEGRAL DATA INPUT WITH RECURRENT FILTRATION SIGNALS OF RADIO
ENGINEERING SYSTEM

UURCHENKO, Yu. S.

[Abstract] Recurrent filtration algorithms realizable by program methods in
microprocessor or computers are widely used in radio engineering systems for
processing of the results of measurements. However, there is a contradiction
between the requirements for fast operation of a computer made by information
users and the condition of optimum processing of signals in a radio engineering
system. Because the cost and yield of a computer substantially depends on fast
operation, it is desirable to find a solution which would make it possible to
obtain a precision of measurements close to potential with a low speed of
operation. It is possible to obtain a solution to this problem, using integral
data input in a recurrent filtration procedure. In the present brief communi-
cation, it is shown that use of integral data input leads to persistance of a
transient process because of infrequent entrance of data. However, the sus-
tained value of the error dispersion differs little from the optimum Kalman
algorithm of filtration. If the fact is taken into consideration that with a
low speed of operation of program means, persistence of the input process is
unavoidable with any method of processing, it is possible to recommend integral
data input into a computer as an efficient method of coordination of radio
engineering systems with computing devices. Figures 1; references: 22 Russian.
[326-6415]

ALGORITHMS OF NONCOHERENT DETECTION OF A SIGNAL ON BACKGROUND OF NOISE WITH
UNKNOWN INTENSITY

VINOKUROV, V. I. and OVCHAROV, Yu. N.

[Abstract] In the case of detection of signals on a background of noise of
unknown intensity, processing structures produced with the aid of a method of
construction invariant to the scale of the detection procedures are widely used.
With noncoherent detection of nonfluctuating signals on a background of normal
noise of unknown power using a graded sampling of noise, the problem is solved
in the literature where it is established that a uniformly most powerful proce-
dure does not exist and a local most powerful (LMP) algorithm is proposed. The
coefficient of asymptotic relative efficiency of this algorithm is compared

with an algorithm optimum for a known source of noise. Two analogous algorithms of noncoherent detection of a nonfluctuating signal on a background of normal noise of unknown intensity are considered, expressions are obtained for evaluation of the power of these algorithms, and their preference in comparison with the known LMP algorithm of detection with a small sampling of noise is established. When used in a digital detection device, these algorithms substantially surpass the digital equivalent of the LMP algorithm, both in characteristics and in the plane for realization. Figures 2; tables 2; references: 6 Russian. [326-6415]

OPTIMUM RECEPTION OF MULTIFREQUENCY SIGNALS WITH RANDOM PARAMETERS

KHARISOV, V. N. and CHERNIKOV, A. A.

[Abstract] A 1978 work from the literature obtains a precise filtration of discrete communication algorithms during observation of a discrete communication of a signal with random continuous parameters on a background of noise. The authors apply the 1978 methods to the problem of reception of a multifrequency signal, which leads to the necessity for consideration of a vector representation of a discrete Markov sequence. As a result, algorithms are obtained for evaluation of an information parameter, optimum with respect to the criterion of a minimum probability of reception error "on the whole", and with respect to the criterion of minimum probability of error of character-by-character reception. Recurrent forms of algorithms are presented which make it possible substantially to simplify their digital realization. Figures 2; references: 5 Russian. [326-6415]

OPTIMUM RECEPTION OF CODE COMBINATIONS OF SIGNALS WITH MARKOV PARAMETERS

TIKHONOV, V. I. and CHERNIKOV, A. A.

[Abstract] In discrete systems of communication by elementary signals with a specific principle (code), various code combinations called "words" can be composed and received by various methods. In the present work, the authors consider a method of reception in which the entire code combination forming a

word is used and by means of this a solution concerned with a transmitted word
(reception of word as a whole) is adopted. The authors note that for the sake
of simplicity in obtaining quantitative results, this paper is limited to the
simplest examples (two determinate signals, reception is accomplished on a
background of adaptive white noise, the time sequence of a signal is a stationary
symmetry Markov chain with two states, various words consist only of two neighbor-
ing signals, ideal synchronization). If even one of the enumerated simplifying
assumptions were removed, the solution formulated for the problem would be sub-
stantially more complicated and deserves an independent consideration. Figures 3;
references 4: 3 Russian, 1 Western.
[326-6415]

FREQUENCY-TIME AND CORRELATION PROPERTIES OF FINITE PARALLEL COMPLEX SIGNALS

GOLIKOV, O. B. and SIKAREV, A. A.

[Abstract] Signals of complex structure find quite diverse uses in communication
objectives, telemetering and radar. The authors consider one of such complex
signals, a rather extensive class of signals which are synthesized from segments
of harmonics, orthogonal at a given interval $t\epsilon[-T/2, T/2]$ of signal duration.
The signals have initial phases of the binary set G_o, π and identical amplitudes.
By virtue of the distinctive features of their frequency-time structure, such
complex signals received the name "parallel." They make it possible to solve a
wide range of applied problems. Problems of a search for optimum solutions in
the case of synthesis of signals with a uniform peak factor, minimum in the inter-
val $t\epsilon[-T/2, T/2]$ are studied, and investigations are made in the plane of fre-
quency-time properties of auto- and mutual correlation functions. In order to
minimize the peak factor, phase codes are attained by direct checking on a com-
puter of all possible sets $Q_r \ \epsilon G_{o,\pi}$ for $N \leqslant 20$. Figures 3; tables 2;
references: 5 Russian.
[326-6415]

FILTER SYNTHESIS FOR OPTIMAL STABLE LINEAR DETECTOR WHERE LIMITED INFORMATION
IS AVAILABLE CONCERNING CHANNEL CHARACTERISTICS

SUTYAGIN, Ye. B.

[Abstract] A communications channel has constant parameters and a finite pulse
response over a specific time interval, while a finite pulsed signal is fed to
the channel input. Optimum stable detection techniques can be used to circumvent
difficulties in detector design which arise where there is an a priori insuffi-
ciency of information on the channel characteristics. The problem consists in
detecting the signal, which is received in an additive mixture of gaussian steady-
state noise, with a linear detector consisting of a linear filter which is immune
to change in the shape of the channel pulse response and a threshold gate. If
the optimal detector is governed by the Neumann-Pearson criterion, then for a
fixed false alarm probability, the signal detection probability is maximized for
the worst case channel pulse response from the class of permissible responses.
In such a detector, the detection probability is uniquely defined by the
signal-to-noise ratio at the filter output. Analytical expressions are derived
for the pulse response of the filter, the signal-to-noise ratio at the output
of the detector, as well as the detection margin. The purely theoretical treat-
ment includes neither sample calculations nor experimental data. References:
10 Russian.
[334-8225]

DIGITAL DATA TRANSMISSION VIA DECAMETER BAND RADIO CHANNELS FOR MARITIME MOBILE
SERVICE

ARZUMANYAN, Yu. V., VENSKAUSKAS, K. K., NAUMOV, A. S., SOKOLOV, B. P. and
CHERKASSKIY, Yu. A.

[Abstract] A receiving station in the Leningradskaya oblast using a R-250M-2
receiver with a BS-2 antenna received digital traffic from ships operating over
two routes (Black Sea--Cuba--Black Sea and Baltic Sea--Cuba--Baltic Sea) using
SSB "Brig" 1.5 KW transmitters in order to test digital communications reli-
ability over a maximum range of 8,000 km in the shortwave band. The data
transmission rate was 100 bit/sec and the following test transmissions for both
day and night operation at frequencies close to the optimal working frequency
were used: 1) A conventional FM signal was transmitted for 5 minutes with a
frequency shift of 170 Hz between key-down and key-up; 2) A signal was

transmitted via 2 parallel FM channels separated by 500 Hz with the transmitter operating in the SSB A3J mode for the next 5 minutes; and 3) For the next 5 minutes, a signal was transmitted via 2 parallel channels spaced 1,500 Hz apart in the A3J mode. The noise situation was observed visually with a S1-34 oscilloscope and an S4-12 spectrum analyzer. The best interference immunity was obtained with an adaptive resolver using signals with a spacing of 1,500 Hz. The use of adaptive processing provided for an error rate of more than $1 \cdot 10^{-2}$ for 90% of the time. If concentrated interference disrupted one of the signal components, adaptive signal processing provided for an error rate of no more than $3.5 \cdot 10^{-2}$ for 90% of the time, while the corresponding values for the FM and linear combination modes were $3 \cdot 10^{-1}$ and $2 \cdot 10^{-1}$, respectively. Figures 3; references: 4 Russian.
[334-8225]

SPECTRAL DENSITY OF RADIO SIGNALS KEYED BY BINARY RANDOM SEQUENCES

KHARISOV, V. N. and NGUYEN DANG MIN'

[Abstract] In this brief communication formulas are obtained on the basis of which expressions can be obtained for the correlation function and the spectral density of radio signals with different kinds of keying: with a constant random duration of the timing interval and with various forms of parasitic fluctuations. A table presents the correlation function and the spectral density of keyed radio signals for a random binary signal, a quasi-telegraph signal and ($N_0 = 0$). Figures 1; tables 1; references: 4 Russian.
[326-6415]

FUNCTIONS OF DISTRIBUTION OF SIGNAL AT PHOTODETECTOR OUTPUT IN OPTICAL DATA TRANSMISSION SYSTEM

KRUPINA, V. L. and MAKKAVEYEV, V. I.

[Abstract] During an investigation of digital systems for transmission of information in the optical range, it is necessary to find a one-dimensional distribution of the signal at the output of the photoconductor-deomodulator

with the aid of which the noise immunity of the system can be determined. On the basis of the concept of noise modulation of a flux of constant intensity, expressions are obtained for the characteristic function of the signal at the output of a photodetector in systems for transmission of optical range data with simultaneous condideration of the most important forms of noise and distortions of the signal. An evaluation is made of the effect of this noise on the statistical characteristics of the signal. It is shown that the mathematical apparatus developed makes it possible to investigate the noise immunity of optical systems for transmitting information, taking into account a number of nonadditive fluctuation processes characteristics of these systems: quantum fluctuations of radiation, fluctuations of the interior amplification of the photodetector, and others. Also considered is the form of the envelope of the optical pulses and the pulse reaction of the receiving device. A table shows the results of processing experimental data. The results of experimental investigations confirm the theoretical conclusions. The results obtained are particularly important in connection with the wide development of work on the creation of fiber-optical communication systems. The fluctuation processes mentioned originate in the principal units of the linear channel of such systems, and for an evaluation of their noise immunity it is necessary to consider together the effect of these processes on the statistical characteristics of the signal. Figures 2; tables 1; references 10: 4 Russian, 6 Western.
[339-6415]

CADENCE SYNCHRONIZATION DURING RECEPTION OF DISCRETE OPTICAL SIGNALS

ZELIGER, A. N.

[Abstract] A cadence synchronization system for an optical receiver is synthesized which synchronizes on the basis of the photoelectron count with the minimum dispersion of the error. The optimization problem is reduced to the problem of maximizing the function $f(\tau|n)$ (n--number of photoelectrons received during the time interval established by the cadence synchronizer, τ--shift of that time interval from its ideal position in time) so that $\tau = \tau_{mo}$ (τ_{mo}--time shift τ measured by the optimum cadence synchronizer on the basis of n), first for a photodetector without internal amplification and then for an avalanche photodetector. A simple algorithm of cadence synchronization is shown together with the corresponding structure of the device. Figures 3; references 3: 1 Russian, 2 Western.
[360-2415]

CONDITIONS OF APPLICABILITY OF GAUSSIAN APPROXIMATION METHOD IN MARKOV
THEORY OF OPTIMAL NONLINEAR FILTRATION

MIRONOV, M. A.

[Abstract] An attempt is made to apply the Gaussian approximation method of
optimal nonlinear Markov filtration to signals with pulse-time modulation which
vary in time much faster than the process undergoing filtration. Instead of
being reduced to an equivalent system of differential equations for numerical
parameters, here the R. L. Stratonovich equation for the a posteriori probability
density is solved on a finite time interval. With the maximum a posteriori
probability as the optimality criterion, the conditions are established under
which this approximation method is applicable. Two of the conditions define the
class of signals and processes to which it is applicable, one condition yields
the threshold signal-to-noise ratio above which it is applicable. Testing for
these conditions requires less machine time on a digital computer than does the
conventional method, although calculations become somewhat more unwieldy for a
signal which is a function of several components, rather than only one, of the
vector of a multidimensional Markov process. Figures 6; references: 12 Russian.
[365-2415]

SYNTHESIZING NONLINEAR AUTOREGRESSION MODELS

PROKHOROV, Yu. N.

[Abstract] Nonlinear adequate autoregression models are synthesized for describ-
ing sequences of signals with a fractional-rational spectrum of extremely high
orders such as speech and other biophysical processes. The problem is formulated
as one of determining the argument of the minimum of a probabilistic parameter
(maximum when the parameter is negative) measuring the proximity of the auto-
regression model to the homeomorphic transform of a sequence of independent
signals. A general solution is obtained, the constant parameters being deter-
mined upon identification of a particular model. Three such models are described:
first-order model for a generalized Gaussian distribution, first-order model
for a generalized Laplacian distribution, continuous model with two-dimensional
nonlinearity. An experimental simulation with these models reveals a resemblance
to a physical pendulum such as in a clock automatically struck at every instant
its oscillations have decayed to a preset level. The author thanks the staff

of Laboratory 3 at tne Institute of Problems in Information Transmission for kind discussions. Figures 5; references 9: 6 Russian, 3 Western (two in translation).
[336-2415]

NONLINEAR AMPLIFICATION OF SEVERAL SIGNALS WITH RANDOM LEVEL VARIATIONS

DEYEV, V. V.

[Abstract] Using a method presented by Deyev in a 1978 work, the present brief communication investigates the effect of a random variation of the levels of input signals on the ratio of the powers of a signal and the combination of third order components at the output of an amplifier with complex nonlinearity. It is assumed that the power variation of each of n independent signals is characterized by a uniform probability density in the interval (P_{min}, P_{max}). An analysis of the graphs calculated for the characteristics of a traveling-wave tube shows that with an increase of the variation of the signal levels at the input of an amplifier, the total power of the combination of components can be larger than the power of the signal. Consequently, the variation of the signal levels must be taken into account during investigation of the various quality indices of the system. Figures 1; references: 3 Russian.
[339-6415]

USING SIMPLIFIED VERSION OF NO 7 SIGNALIZATION SYSTEM DURING NON-CONNECTED OPERATING CONDITIONS

VASIL'CHENKO, A. I., ZHARKOV, M. A., LUTOV, M. F. and YUNAKOV, P. A.

[Abstract] During development of automatic telephone station (ATS) with program control, much consideration is given to problems of a general signaling channel (OKS). A combination of program control and OKS makes it possible to increase the effectiveness of operation of the network and the quality of maintenance and to reduce the volume of equipment for ATS. Within the scope of the International Telegraph and Telephone Consultative Committee (MKKTT), a system of signalization has been developed in terms of OKS—System No 7 which is

intended for operation at various sections of telephone networks with systems
of transmission with time and frequency separation of channels and by physical
lines with various rates of transmission of signal communication. The No 7
system of signalization together with the principal variation of realization has
some modifications, among which is a simplified variation of the No 7 system
which has the smallest volume of equipment. The object of the present paper is
to determine the acceptable capacity of a bundle of voice-frequency channels
serviced by one OKS with various numbers of retransmission points and progation
times of a signal at each section of the OKS. In the process the qualitative
index of the operation of the OKS is fulfilled--the probability of a delay of
communication in the OKS greater than the specified t must exceed Q. The
principles of operation of a simplified version of System No 7 is described.
Figures 1; references: 6 Russian (includes 3 MKKTT documents in Russian).
[337-6415]

METHOD OF DISTANT POWER SUPPLY FOR UNATTENDED AMPLIFYING POINTS

PINSKIY, I. M., senior engineer, TTsUMS-4

[Abstract] The paper describes work done at the Territorial Center for Control
of Long-Distance Communications and Television No 4 (TTsUMS-4) on the elimination
of certain shortcomings in the distant power supply (DP) for unattended ampli-
fying points. A table presents data on the load currents in various circuits
of a DP. The correction circuit of a DP for a one-quaded cable and the correc-
tion circuit of a conductor-conductor DP are presented and explained. The
circuits of the DP of the K-60 and U-60Ye transmission systems are also discussed.
Figures 3; tables 1.
[355-6415]

MATHEMATICAL MODEL FOR DETERMINING FIELD OF APPLICATION OF MKKTT
SIGNALIZATION SYSTEM NO 7 ON URBAN TELEPHONE NETWORKS

SOKOLOV, N. A.

[Abstract] The mathematical model proposed in this paper for determining the
field of application of the International Telegraph and Telephone Consulative
Committee (MKKTT) system of signalization No 7 on urban telephone networks makes

It possible to determine analytically the required characteristics for construction of the field of application of a general signaling channel (OKS): mathematical expectation of the delay time of SU and the probability of delay of SU over a permissible magnitude. The Poisson nature of the incoming flow at each phase makes it possible quite simply to determine the characteristics of a network of OKS by the analogous characteristics of the individual phases. Figures 2; references: 9 Russian.
[337-6415]

AUTOMATED CENTRALIZED SYSTEM OF TECHNICAL MAINTENANCE OF IKM-30 EQUIPMENT FOR URBAN TELEPHONE NETWORKS

BERLIN, B. Z., KOSTIN, A. A., MALYSHEV, A. L. and MOROZOV, G. G.

[Abstract] Specialists of the Leningrad Electrical Engineering Institute imeni Professor M. A. Bonch-Bruyevich, the Leningrad Urban Telephone Network and the Leningrad Branch of the Central Scientific-Research Institute of Communications (TsNIIS) developed an automated centralized system of technical maintenance (ACSTM) of the IKM-30 equipment for urban telephone networks. The present paper considers the problems which arose in creating the ACSTM. The following items are examined: 1) Functional problems of ACSTM; 2) Structural synthesis of ACSTM; 3) Softward for ACSTM (a block diagram of the software system is presented and a micro-computer of the "Elektronika S-5" series is used); 4) Stages of introduction of ACSTM into an urban telephone network. Economical effectiveness of ACSTM; and 5) Experimental ACSTM. It is concluded that creation of the ACSTM assures a reduction of the cost for technical maintenance of a digital transmission system (DTS) with a simultaneous increase of the quality of transmission. The results of test exploitation of the system made it possible to formulate concrete requirements touching upon modernization of IKM-30 equipment in part of the technical maintenance and creation of subsequent generations of DTS. Introduction of the ACSTM assures transition to a monitoring-correcting method of technical maintenance of the IKM-30. It will determine the necessity for development of centers of technical exploitation for integrated digital communication networks, which make it possible subsequently to achieve dynamic control of a digital communications network. Figures 4; references 8: 5 Russian, 3 Western.
[337-6415]

CALCULATING OPTIMUM WEIGHT PROCESSING OF COHERENT PULSE ENVELOPES

KOSHEVOY, V. M.

[Abstract] An expression is given for the optimum weight processing of coherent
pulse envelopes which realizes the maximum value of the ratio signal/interfering
reflection + noise. Proceeding from this, the optimum weight coefficient of a
filter during a change of the magnitude of the Doppler misalignment between a
signal from the target and from the interference reflection is calculated on the
basis of the same reciprocal matrix as in the absence of such an additional
misalignment. Thus for the case, common in practice, of a symmetrical form of
the spectrum of fluctuations of the interference reflections, it is possible to
operate without conversion of a complex matrix. For this it is sufficient to
calculate the reciprocal matrix for the situation when it is valid (e.g.,
during absence of Doppler misalignment between the signal form the target and
form the interfering reflection) and on the basis of this valid matrix to cal-
culate the complex weight coefficient for an arbitrary value of the misalign-
ment. Equation 3 in the text can be used for an increase of the efficiency of
rearrangement of adaptive systems of open type, under construction of the
basis of optimum weight filters. Such a system consists of a set of filters
adjusted to various target speeds in a specified range, the weight coefficients
of which are rearranged in accordance with a measured correlation interference
matrix. In the process calculation of a reciprocal matrix is only possible for
a one-speed channel, and for the remaining channels the weight coefficients are
calculated according to equation (3) in the text. This equation is valid for
any discrete signal. References 2: 1 Russian, 1 Western.
[339-6415]

MULTICHANNEL DEVICE FOR SIGNAL SEARCH WITH PULSE COUNTERS

OZERSKIY, Yu. P. and SHERSTNEV, Ye. A.

[Abstract] This brief communication presents the results of an investigation
of the properties of a multichannel device for search for a binary-quantized
signal with a nonfixed search time, which contains N pulse counters. The
algorithm of its operation is included in a count (accumulation) of the number
of quantized pulses which appear at each of N sections at the time of search and,

in comparison with it, each period of repetition of a signal T_8 with a certain
threshold. The search is continued as long as the threshold is not reached.
If the threshold is reached for one section, then this section is notified by
a signal. If the threshold is reached at one for $k(2 \leqslant k \leqslant N)$ sections, then a
signal section is selected from them on the basis of additional a priori data
and during the absence of such data, the equally probable. Figures 3;
references: 3 Russian.
[326-6415]

PULSE INTERFERENCE AND ANALYSIS OF NOISE IMMUNITY (SURVEY)

KUZ'MIN, B. I.

[Abstract] A survey is made of USSR work concerned with the basic physical
and statistical characteristics of pulse interferenc/ (PI) and the procedures
for analysis of the noise immunity of discrete communication channels. The
following concepts are considered: 1) Physics of PI; 2) Amplitude statistics;
3) Flow statistics; 4) Characteristics at output of receiving channels;
5) Analysis of noise immunity. It is concluded: 1) As a scientific and applied
task, the problem of protection from PI arose from the earlier problem of re-
ception on a background of adaptive Gaussian noise. However, up to now, as a
consequence of considerable mathematical difficulties, there is no fully analy-
tical solution to this problem. Partial results can only be obtained for com-
paratively simple approximations of a general model. 2) Abroad, interest in
PI increased during the last 10 to 15 years. In the USSR, the struggle with this
form of interference has been given much attention at all stages of radio
engineering development. In the process, fundamental results were obtained in
the field of protecting receiving devices. Because PI is a nonGaussian random
process of a nonstationary type, in order to determine the losses, accuracy
is necessary in obtaining present identification with the goal of exposure of
local stability intervals and an analysis of them within the limits of amplitude
and flow statistics. In essence an analysis of the noise immunity of receiving
devices with the effect of powerful PI must take into consideration the effect
of the type and parameters of selective channels on the amplitude and flow
statistics of PI and the characteristics of the action of multiposition computing
devices. References 68: 66 Russian, 2 Western.
[326-6415]

ESTIMATING SELECTIVITY OF MODERN RECEIVERS FOR CASE OF SINGLE INTERFERING
SIGNAL AT INPUT

BORISOV, V. I.

[Abstract] Receiver selectivity is currently estimated in light of a large
number of criteria, e.g., the rectangularity of the primary selection filter,
the bandwidth within which the useful signal is not blocked by an interfering
one, the degradation of sensitivity by an interfering signal at the IF or image
frequency; cross-modulation interference as well as spurious heterodyne noise
and frequencies. This paper is an attempt to derive an analytical expression
in order to estimate frequency selectivity, which makes it possible to combine
all of the existing estimation criteria. The analysis assumes that because of
interference the sensitive degradation is caused by the following three factors:
1) The interference is fed directly to the detector input; 2) Noise and spurious
components in the beat frequency output intrude into the IF channel; and 3) The
front end amplifier and mixer of the receiver are blocked by the interfering
signal. A cumbersome analytical expression is derived which makes it possible
to estimate reception reliability when the receiver is exposed to a single inter-
ference component and takes into account the impact of the parameters of the
major receiver components on reception. The simplification of this cumbersome
expression for practical purposes by approximating the filter transfer functions
with linear functions is noted, though not explained in any detail and no sample
calculations or experimental data are adduced. Figures 2; references 6:
5 Russian, 1 Western.
[334-8225]

SYNTHESIS OF OPTIMAL DIGITAL TRACKING FILTRATION

DUDAROV, V. N. and KROKHIN, V. V.

[Abstract] A linear digital system of Kalman filtration is synthesized which
will yield the optimum estimate of an input process, the latter being a poly-
nomial of an arbitrary degree with random coefficients and appearing at the
filter input at discrete instants of time. Calculations are made with the aid
of recurrence relations and the structure of such a system is designed accordingly.
The relative dispersion of the filtration error has been calculated for a system
with either variable or constant parameters of second-order astatism in relative

time and for an exponential correlation function of the input process. Increasing the constant gains decreases the error at the beginning of the transient and increases it in the steady state. Variability of the parameters decreases the filtration error. Figures 2; references 4: 2 Russian, 2 Western (one in translation).
[360-2415]

CORRELATION PROCESSING OF SIGNALS ON BASIS OF PHONON ECHO PHENOMENON

BONDARENKO, V. S., KNYAZEV, O. N. and SOKOLOV, S. L.

[Abstract] As shown in the literature, investigations of a phonon echo in crystalline powders of a number of piezoelectrics, by two- and three-pulse methods, revealed the effect of dynamic storage in the course of tens of microseconds and quasi-static storage during several 24-hour periods. The authors consider a method of correlation processing of signals with use of the phonon echo effect. A physical model of a phonon echo is presented, and the functional capabilities of devices based on the phonon echo phenomenon are studied. Circulation-filtration processing (time compression) of signals is experimentally conducted with linear frequency modulation and phase-code modulation of a binary M-sequence of maximum length. The results of the experiments are presented in two tables. A block diagram is shown of the model of a phonon processor. It is concluded that in the case of practically any specified effect, a phonon processor is an analog of a matched filter, which possesses both dynamic storage with a two-pulse compression regime and quasi-static (long duration) storage with a three-pulse compression regime. The latter makes it possible to turn repeatedly to the storage of the processor, which can be very useful in the case of specific methods of processing radio engineering data. Transitional attenuation (ratio of echo-signal amplitude to the amplitude of actuating pulse) can be considerably reduced by a decrease of the clearance between the capacitor plates with a working medium up to 0.1 mm and less. The experiments conducted conform the accuracy of the conclusions concerning the relations between the spectra of the phonon echo signal and the spectra of the effect of pulses. Figures 4; tables 2; references 9: 6 Russian, 3 Western.
[328-6415]

DELTA-MODULATOR IN FIBER OPTICS COMMUNICATION LINE

KASHUBA, A. A. and FELINSKIY, G. S.

[Abstract] This brief communication considers a device with delta-modulation
(DM) in a model of a fiber communication line with forward current modulation
of a light-emitting diode. A block diagram of the model is presented and ex-
plained. The voice signal enters into a linear amplifier with a transmission
band of $100 \div 5000$ Hz. The continuous analog signal proceeds from the output
of the amplifier to the delta-modulation coder. A light-emitting diode with a
radiating power of 0.2 mW and a wavelength of 0.95 micrometer is mounted in the
housing which assures link-up of the luminous area of the light-emitting diode
with the light-carrying core of the optical fiber with a precision of $\pm$ 3
micrometer. A gradient fiber module with a length of 100 m has introduced
losses of $\sim$ 5 dB/km, a numerical aperture of 0.29 and the diameter of the light-
carrying core of 40 micrometer. Operational amplifiers 140 U D1B were used in
the circuit as active elements for amplifiers and an active R-C filter. Use of
the DM optical-fiber communication makes it possible to cncrease the information
capacity of a channel and length of the line without retransmitters because of
the increased noise immunity. An important merit of such systems during trans-
mission of signals at large distances under conditions of considerable electro-
magnetic interference is the increased noise immunity. Figures 1; references:
4 Russian.
[339-6415]

CHANGING EQUIPMENT EFFICIENCY WHEN IMPROVING ITS ELECTROMAGNETIC COMPATIBILITY
INDICATORS

KALUZHSKIY, A. D.

[Abstract] Electromagnetic compatibility for communications facilities can be
solved in two ways: by improving the compatibility indicators of the communica-
tions gear, something which complicates the hardware, increases its weight, size,
etc., or by means of the frequency adaptation of the radio equipment to the
changing conditions, particularly far and near field interference as well as
propagation conditions. The trade-off is then be ween improving electromagnetic
compatibility indicators while a number of other parameters are degraded; the
better the compatibility indicators, the worse the other parameters. This paper

is a general mathematical attempt to optimize this trade-off between compati-
bility and hardware indicators simultaneously. The treatment generates ex-
pressions in matrix form which define curves illustrating this compromise,
with the optimal conditions being the peak of a single curve synthesized from
a pair of exponentially increasing and decreasing curves. No sample calculations
or experimental data are given. Figures 1; references 9: 8 Russian, 1 Western.
[334-8225]

ADAPTIVE OPTIMUM DETECTOR OF COHERENT MULTIPULSE SIGNAL ON BACKGROUND
ADAPTIVE MIXTURE OF PULSE INTERFERENCE AND NONCORRELATED NOISE

BARANOV, P. Ye. and TOKOLOV, V. S.

[Abstract] A 1977 paper by Baranov considers the problem of synthesis of an
optimum algorithm of the detection of a coherent packet of a signal with intra-
pulse modulation which is masked by an additive mixture of pulse interference
and noncorrelated noise, under the assumption of the known statistical charac-
teristics of interference. It is shown that an optimum receiver synthesized on
a basis of the ratio of probability is a coherent-weighting storage device. The
optimum procedure for detection of a coherent multipulse signal under conditions
of an additive mixture of pulse interference and noncorrelated noise reduces
to suppression with a weight $1/(1 + \gamma)$, where γ is the ratio of the powers of the
pulse interference to the noncorrelated noise, of sample values affected by the
pulse interference, with subsequent coordinated intra- and interperiod treat-
ment. If the parameters of the powers of the pulse interference and noncorre-
lated noise were known a priori, then the problem of synthesis of an optimum
receiver (digressing from difficulties of technical realization) might be con-
sidered to be solved. In practice, however, knowledge concerning interference
is absent as a rule. Consequently, the present brief communication investigates
adaptive algorithms which continuously adjust themselves to the interference
conditions. The results of this investigation shows that use of an adaptive
algorithm makes it possible to assure interference immunity sufficiental close
to the potential under conditions of varying interference circumstances.
Figures 1; references: 4 Russian.
[326-6415]

AUTOMATION OF RURAL WIRE-COMMUNICATION EXCHANGE OFFICES

URAKOV, G. V., chief, and SHESTOPALOV, V. I., senior engineer, Radio Service at the Zaporozh'ye, OPTUS (Department of Industrial-Technical Communication Management)

[Abstract] Automation of rural communication exchange offices is being extended beyond simple switching of the repeaters, namely by also providing remote control. Both wireless and wire systems are used for this purpose, generally the former with A-600, DUET, TUPV-0.25x2 equipment and the latter with AVSP-OSA equipment, the relative merits and drawbacks of each being considered in the planning. In the Zaporozhye region such a conversion of wire communication to automatic and remote control proceeds zone by zone, is the most economical way with maximum utilization of available equipment. The aim is to provide a class-2 communication channel up to 6 kHz. This can be achieved with appropriate low-pass filters, using 14-19 microHenery variable inductance coils with large capacitors, and by 2-stage switching twice during the 12-cycle period between transmitter and receiver with a discretization frequency of 16 kHz. This should reduce the channel nonuniformity to 2 dB and provide adequate suppression of higher-frequency signals (8 kHz by 35 dB). No modification of existing IKM-12 bays with ZONA equipment is necessary, only six 024D cells are needed and no AVSP channel equipment. It would be desirable, nevertheless, that new equipment be developed which would perform all the functions of AVSP and AKRU equipment, as well as for remote inspection and measurements. Figures 4.
[364-2415]

MODERNIZING 'CONTAINER' EQUIPMENT

SHEYNBROT, V. Z., engineer

[Abstract] The paper describes the reprocessing of the design of the "container" equipment for multichannel radio relay lines. This equipment is used for organization of trunk lines between manual and automatic telephone stations, as well as for organization of automatic transit through automatic telephone exchanges of rural telephone networks. A table of the characteristics of the "container" equipment, before and after modernization is presented. Tables 1.
[355-6415]

COMPONENTS AND CIRCUIT ELEMENTS,
WAVEGUIDES, CAVITY RESONATORS
AND FILTERS

SUBNANOSECOND SHUNT-ATTENUATOR BASED ON SECTIONS OF LONG LINES

ZHELTOV, K. A., MATAKOV, V. I. and SHALIMANOV, V. F.

[Abstract] The principal circuit is illustrated and explained of a shunt
based on sections of long lines with an output cable attenuator, which was
developed for registration of subnanosecond current pulses with an amplitude > 3 kA
in the beam of an electron accelerator. A relationship is presented for deter-
mining the attenuation factor and the choice of impedances which assure compen-
sation for reflections. An oscillogram is shown of the electron current of an
accelerator with an amplitude of 3 kA, obtained with a shunt made of
RK-75-1.5-11 cable from 58 sections of a line, each 1.5 meter long which was
loaded by an attenuator based on sections of RK-75-9-13 cable. Figures 2;
references: 1 Russian.
[320-6415]

LOW-IMPEDANCE ALL-PURPOSE CAPACITOR MODULE WITH ENERGY CONTENT OF 112 KILOJOULE

BURTSEV, V. A., MAKEYEV, G. M. and PROKOPENKO, V. F.

[Abstract] The paper describes an all-purpose low-impedance capacitor module
with an energy content of 112 Kilojoule, assembled from 15 IK-50-3 pulse
capacitors with a paper-oil (castor oil) dielectric. An overall view of a
module with four solid-state spark gaps is presented. The capacitors in the
model are connected in parallel with the aid of wide metal busbars constructed
with film polyethylene insulation ~3 mm thick, which makes it possible to shorten
the frequency of discharge of a module in the case of a short circuit, to the

natural frequency of the capacitors. The module is provided with dischargers
with a solid dielectric. As compared with vacuum and gas commutators, similar
dischargers possess a lower natural inductivity and high electric strength.
Unfortunately, however, they have a rather high spread of the actuation time
delay. One of the principal objects of the present work was a study of the
possibility of synchronization of the dischargers by polyethylene as a dielectric
with a precision of $\sim$ 0.1 microsecond with an operating voltage to 100 kV.
Construction of the capacitor module makes it possible to operate with various
loads. During charge of a section by voltages of different signs, experiments
were possible with loads having a ground midpoint (-50 kV, 0-50 kV). Parallel
operation of sections can be accomplished at loads with 3-busbar current-conduc-
ting lines ($\pm$ 50 kV, 0). In these regimes all the dischargers of both sections
are utilized. Asynchronous operation of the dischargers is conducted to $\leq$ 100
nanosecond, with a charge voltage up to 100 kV. The authors thank A. B. Andrezen
and V. M. Vodovozov for helpful discussions. Figures 3; tables 1; references:
4 Russian.
[320-6415]

SYNTHESIS OF ACTIVE AND PASSIVE STRIPLINE FILTERS WITH LOSSES

GUSEVA, M. N.

[Abstract] A method is proposed which makes it possible to calculate the con-
struction of microwave passive filters-preselectors, filters with an arbitrary
complex load, filters with negative resistance in a network, and filters of
combined structure. Calculation of microwave filters is fulfilled in two stages,
which are explained. The method is illustrated, using as an example obtaining
the calculated relations for a stripline filter based on resonators formed by
segments open from two sides of coupled half-wave lines with negative resistance
in the last circuit. The proposed method can be used for synthesis of microwave
filters of various constructive accomplishments as well as for synthesis of
filters, the construction of which, in accordance with additional technical
requirements, must be combined with various structures. Figures 3;
references 7: 5 Russian, 2 Western.
[331-6415]

ELECTROMAGNETIC EXCITATION OF TWO SEMIINFINITE COAXIAL CIRCULAR WAVEGUIDES BY
MODULATED CURRENT WITH STATIONARY DISTRIBUTION

IRKEGULOV, A. Sh., URAZAKOV, E. I. and SHVACHKA, A. B.

[Abstract] The electromagnetic excitation of a coaxial waveguide in open space
by an annular source of azimuthal monochromatic alternating current is calculated
by the factorization method. The waveguide consists of two semiinfinite circular
tubes with the end of the outer one projecting beyond the end of the inner one,
and the source constitutes a coaxial finite array of thin ring conductors inside.
The current in such a source is generated by a microwave oscillator, a magnetron
or a klystron. The problem reduces to a matrix system of Wiener-Hopf-Fock inte-
gral equations with kernels resolvable into two factors which have no singulari-
ties in the lower half-plane and which increase in this half-plane not faster
than according to a power law as the frequency increases infinitely. The angular
distribution of the electric field intensity caused by symmetric magnetic waves,
calculated by numerical simulation on a BESM-6 computer according to a special-
purpose program written in FORTRAN and including a CAUCHY deck, is found to be
highly directional with a sharp peak within the $\frac{\pi}{2} \leqslant \theta < \pi$ sector whose location

depends on the location of the current source as well as on the transverse
dimensions of the waveguide. The authors thank Ye. P. Zhidkov and V. G. Makhan'kov
for stimulating discussions. Figures 4; tables 1; references: 11 Russian.
[365-2415]

CONSTRUCTING POLYNOMIAL MODELS DESCRIBING ELECTRICAL PARAMETERS OF RECTANGULAR
WAVEGUIDES WITH T-SLOTS BY METHOD OF PLANNED EXPERIMENT

ALEKSEYEV, Yu. V., ZHELEZOVSKIY, B. Ye., KAPITONOVA, T. A. and SHNEYDER, M. Ye.

[Abstract] The method of a planned experiment is applied to the construction of
polynomial models describing the electrical parameters of rectangular waveguides
with a T-slot. The five basic geometrical dimensions of the T-slot, referred to
the width or the height of the rectangle, or to one another, serve as the factors
in the experiment. Accurate models can be obtained by a rototabular central
composition plan, as indicated by calculation of the critical H_{10} and H_{20} modes
agreeing closely within 3% with experimental data on the transfer function of
appropriate rejection filters. Tables 2; references: 3 Russian.
[360-2415]

ANALYSIS OF COUPLED WAVEGUIDE DIELECTRIC RESONATORS

KAPILEVICH, B. Yu.

[Abstract] A rigorous analysis is made of two coupled waveguide-dielectric
resonators in a limiting waveguide, allowing for the conditions of excitation
in sections of the regular-limiting waveguide. The dependences of the coupling
coefficient and the external Q on the penetrability and geometrical factors are
obtained. The results are presented of an experimental verification of the
calculated data in the 3-cm band. The calculated and experimental data agree
well. Figures 5; references 5: 3 Russian, 2 Western.
[331-6415]

SURFACE WAVES IN FERRITE-DIELECTRIC FILLED PLANE WAVEGUIDE

IVANOV, V. N., TOLSTOLUTSKIY, S. I. and SHCHUCHINSKIY, A. G.

[Abstract] In order to create wide-band unidirectional elements, microstrip
lines (MSL) with a transverse-laminated ferrite-dielectric substrate are used.
Experimental investigations show that the lowest types in such lines are the
surface waves propagating along the interface ferrite-dielectric. Because of
this a plane waveguide with a wide conductor on a thin transverse-laminated
substrate is used as model of MSL. Dispersion characteristics calculated with
the aid of this model, with identical dielectrics ($\epsilon_1 = \epsilon_2$) was qualitatively
confirmed. However, in the case $\epsilon_1 = \epsilon_2$ the structure under consideration does
not assure by itself unidirectional properties, i.e., in real devices $\epsilon_1 \neq \epsilon_2$.
In the present work, the authors calculate the dispersion characteristic and the
distribution of fields, and the longitudinal component of the Umov-Poynting
vector P_z in a plane waveguide with transverse-laminated ferrite-dielectric
filling, when the dielectric constants are different $\epsilon_1 \neq \epsilon_2$. Unidirectional
propagation in a plane waveguide with a transverse-laminated ferrite-dielectric
filling can be realized in a wide-frequency band (more than an octave) when the
forward wave is surface and the backward is a resultant. It can be expected
that wide-band elements based on this principle will conform well with microstrip
channels, and the direct losses in it will decrease because of shift of the field
from the ferrite and dielectric. In addition, when both the forward and backward
waves are surface, the structure under consideration can be used for the creation

of wide-band unidirectional phase shifters. The authors thank A. M. Lerer for useful discussion of the results of the work. Figures 4; references 6: 1 Russian, 5 Western.
[328-6415]

CALCULATING EIGENWAVES OF MICROSTRIP LINE

KOVALENKO, A. N. and FEDOROV, A. N.

[Abstract] A 1978 paper by Kovalenko showed the effectiveness of using Chebyshev polynomials for construction of a system of base functions and accomplished a procedure for improvement of the convergence of series for the coefficient of a system in the case of shielding a microstrip line (MSL). In the present work, the numerical method of calculation of eigenwaves proposed in the 1978 work is generalized to an open MSL (for nonradiating types of waves). The procedure is stated for improvement of the convergence of improper integrals for elements of the matrix of a system of linear algebraic equations. Relations are presented which make it possible to determine the order of the system as a function of the parameters of the line. On the basis of the proposed scheme, calculations are made of the propagation constant and the wave impedance of the MSL over a wide range of changes of the parameters. The dispersion equations were solved on the "YeS-1022" computer. The results of the calculations are composed with analogous results for a shielded line. The effectiveness is shown of the numerical method of calculating eigenwaves of MSL, based on a solution of the integral equations by the Galerkin method with the use of Chebyshev polynomials and improvement of the convergence of expression for matrix coefficients. An expression is derived which makes it possible to establish the bound of applicability of a quasi-statistical theory of MSL. The numerical results obtained can be used for determining the precision of the asymptotic theory of nonradiating waves of MSL. The method also extends to other types of strip and slot lines. It is significant that the algorithms developed in conformity with the procedure makes it possible with high precision to determine not only the propagation constant, but also the field. Figures 3; tables 1; references 5: 4 Russian, 1 Western.
[328-6415]

CALCULATING ELECTRICAL PARAMETERS OF SLOT LINE WITH STRIPS OF FINITE WIDTH

MASTERKOV, A. S., MEYEROVA, R. S., FIKHMANAS, R. F. and FRIDBERG, P. Sh.

[Abstract] A slot line on a dielectric substrate is considered, which consists of two strips of finite width. Its characteristic impedance and effective dielectric permittivity are, in the TEM-mode approximation, expressed solely through the capacitance per unit length. This capacitance is calculated from the solution to the two-dimensional problem of electrostatics for the given geometry. The capacitance functional is evaluated numerically by an earlier proposed method involving the Fourier transformation. The results are comparable with experimental data. Figures 2; references 5: 3 Russian, 2 Western (one in translation).
[336-2415]

DISPERSION CHARACTERISTICS OF OPTICAL DIFFUSION-TYPE STRIPLINE WAVEGUIDE

GOROBETS, A. P. and DERYUGIN, L. N.

[Abstract] One method of producing optical miniature stripline waveguides is implantation, by diffusion, of an impurity which increases the refractive index of the substrate. The field of such a waveguide with the refractive index increasing smoothly depthwise across the diffusion layer is represented as the sum of two waves refracting in the plane of the stripline symmetrically with respect to the longitudinal axis. After the corresponding wave equation has been solved by the Wentzel-Kramers-Brillouin method for the propagation constant, the effective refractive index is calculated in the Wentzel-Kramers-Brillouin approximation. The distribution of the refractive index across the diffusion layer, in terms of two exponentially decaying error functions, has been calculated for a thin stripline waveguide of width 2a produced by diffusion of lead oxide into glass. On this basis, then, the dispersion equation has been evaluated numerically and the dispersion curves plotted for the transverse and normal components of the electric field modes $E_{11}-E_{51}$ in such a waveguide at the $\lambda = 0.63$ micrometer wavelength. Figures 2; references 15: 7 Russian, 8 Western (one in translation).
[365-2415]

EXCITATION OF OPEN RESONANT STRUCTURE IN FORM OF DISK PINNED BETWEEN PARALLEL PLANES

BUTORIN, V. M. and FIALKOVSKIY, A. T.

[Abstract] Resonators in the form of a disk on a pin between parallel planes are widely used in microwave technology for matching active or passive semiconductor devices to transmission lines. Here a theory of such a resonator structure is developed, considering its excitation by radial waves of both polarizations which decay exponentially toward the center of the disk. The space between the horizontal disk (on a vertical pin) and the metal support plate underneath is filled with a dielectric. No constraints are imposed on the geometry of this structure, but the problem is treated utilizing its axial symmetry. A numerical solution according to a program for calculating the reflection coefficient and the amplitudes of higher harmonics, due to the disk response, has yielded the edge response and the natural frequency of the disk as well as the transformation characteristics of the structure and its coupling to a radial transmission line. The results can be useful for the design of housings for semiconductor microwave devices. Figures 6; references 8: 2 Russian, 6 Western.
[336-2415]

FAST SYNTHESIS OF MATCHING FILTER

SMAGIN, I. I.

[Abstract] A procedure is proposed for fast synthesis of matching filters which involves frequency transformation of the modulus of the transfer function squared. Its three steps are: 1) Solving the approximation problem with the constraints on the filter characteristics taken into account and determining the poles of the transfer function of the prototype filter; 2) Scaling those poles to poles of the matching filter; and 3) Realizing the transfer function of the matching filter. This procedure is demonstrated on a fourth-order low-frequency LC filter with a maximally smooth characteristicsin the pass band, a $\Delta\alpha_0 = 3$ dB nonuniformity factor and a $\omega_1/\omega_h = 0.6$ ratio of cutoff frequencies. Figures 3; references 3: 2 Russian, 1 Western (in translation).
[360-2415]

SYNTHESIS OF DIGITAL FILTERS FOR CASCADE OF NONRECURSIVE AND RECURSIVE STAGES

POPOV, D. I. and GUS'KOV, S. V.

[Abstract] A system of digital filters for data processing is considered which
generally consists of p nonrecursive first-order stages, r recursive first-order
stages, s nonrecursive second-order stages and q recursive second-order stages.
The synthesis of such filters on the basis of the transfer function squared re-
duces to the solution of the system of the corresponding number of equations for
the constraints on that square of the transfer function at the characteristic
points. It does not involve any constraints on the relation between the number
of zeros and the number of poles in the system function. The method applies to
filter cascades with any numbers of nonrecursive and recursive first-order and
second-order stages. Figures 2; tables 1; references 4: 1 Russian, 3 Western
(all in translation).
[360-2415]

METHOD OF SYNTHESIZING DIGITAL NARROW-BAND FILTERS WITH FINITE LENGTH PULSE
CHARACTERISTICS

VITYAZEV, V. V., MURAV'YEV, S. I. and STEPASHKIN, A..I.

[Abstract] The intense increase of the degree of integration of the elemental
base of computing techniques, the increase of its reliability with a simultaneous
decrease of the cost of one typical element, lead to the possibility of practical
realization of contemporary radio-electronics equipment on the basis of digital
processing of signals, among which one of the prominent positions is occupied
by digital frequency selection. In the present paper the problem is considered
of frequency selection of the components of a group signal which consists of
the synthesis of a set of digital band-pass filters (DBF) with finite length
pulse characteristics (KIKh), covering the range of working frequencies of a
receiving system. A comparison is made of the various realizations of a set of
DBF, and a method for synthesis of the structure of such a set is presented. It
is concluded that realization of a set of highly-selective ($\alpha < 1$) narrow-band
KIKh-filters in terms of a two-stage structure, on the basis of a modified direct
convulation, is the most rational with respect to a generalized criterion of
quality. The instrumental precision, the equipment and time expenditures were
taken into account. Figures 3; references 6: 5 Russian, 1 Western in
translation.
[339-6415]

TIME FUNCTIONS OF NARROW-BAND REJECTION FILTERS

NAROUSHVILI, V. V.

[Abstract] A narrow-band rejection filter is obtained by means of frequency
conversion from a low-frequency prototype; the response of this filter to an
arbitrary RF signal is analyzed based on the technique of slowly changing
amplitudes proposed by Zucker [BELL SYSTEMS TECHNICAL JOURNAL, 1974, No 2],
although the proposed method does not require the laborious determination of a
truncated filter transfer function. Analytical expressions are derived which
define the timewise processes of amplitude and phase settling in Butterworth
rejection filters. Calculations were performed on a Minsk-22 computer to com-
pare results from the improved truncated approach with those of precise calcu-
lations. The error from the proposed expressions depend primarily on the
relative stop bandwidth of the rejection filter and the degree of mismatching.
It is illustrated graphically that the error in the calculation of rejection
filter response using the proposed technique can be disregarded in practice
if the relative stop bandwidth is less than 0.1, a condition which is nearly
always the case in practice. Figures 3; references 5: 4 Russian; 1 Western.
[334-8225]

NATURAL OSCILLATIONS OF RING-TYPE DIELECTRIC MICROWAVE RESONATORS

CHERNIY, B. S.

[Abstract] At present ring-type and coaxial dielectric resonators find wide
use in functional microwave devices as elements of filters of reconstructed and
thermocompensated oscillatory systems. Nevertheless, in known works theoretical
investigations of natural oscillations of such resonators are conducted with
insufficient completeness. Calculations have been made for ring-type dielectric
resonators (RDR) of the optical range of wavelengths with the condition $\varepsilon \geqslant 1$ and
large radiuses of curvature R in comparison with the wavelength λ in the material
of the resonator, or with considerable simplifications with $\varepsilon \gg 1$ and $\sim \lambda$. In
the present paper an electrodynamic model of a RDR is considered for symmetrical
and hybrid types of oscillations with continuous tangential components of the
electromagnetic field at the ring and cylindrical boundary surfaces. At its
base is placed a single-wave approximation of the fields in the partial regions
formed by the coordinate surfaces. The characteristic equations obtained

determine the resonance frequencies of the natural oscillations of the RDR of
the microwave range with $\varepsilon \gg 1$ and take into account the dependence of the
transverse wave numbers on the parameters of the resonator. A theoretical
analysis is made of the dependences of resonance frequencies for the lower
H_{01_δ} and other types of oscillations on the geometrical dimensions of the RDR.
It is shown that the perturbation of the fields of a dielectric resonator cavity
with axial symmetry reduces to a rarefaction of the lower part of the spectrum
of natural oscillations, which makes it possible in a number of practical cases
to eliminate parasitic resonances in an interesting band of frequencies. The
results are given of an analysis of the distribution of the components of electro-
magnetic fields for H_{01_δ}-type oscillations. Figures 6; references 9: 3 Russian,
6 Western.
[331-6415]

SYNTHESIZING TUNABLE BAND FILTER WITH AID OF GRAPHS

OSTAPENKO, A. G.

[Abstract] Synthesis of economically and simply tunable band filters is con-
sidered which will ensure an adequately good and constant pass band over the
entire tuning range. Accordingly, a transfer function of the lowest possible
order is selected: with a quadratic polynomial in the denominator. It is
transformed so as to correspond to an inverting integrator as the basic element.
Meanwhile, the signal flow graph is divided into subgraphs and to each of those
is matched a subcircuit with the appropriate components and characteristics.
Such a filter was built experimentally with K284UD2 microcircuits. The pass band
of its amplitude-frequency characteristic was found to vary within the 15-20 Hz
range as its resonance frequency was tuned over the 1-3 kHz range. Figures 3;
references: 7 Russian.
[336-2415]

STUB WAVEGUIDE DIRECTIONAL COUPLERS WITH NEW VARIETY OF COMMUNICATION ELEMENTS

AL'TSHULER, Yu. G., SVYATOGOROV, S. A. and SOSUNOV, V. A.

[Abstract] This brief communication is a continuation of work done by the
authors in 1975 and 1979. The employment in stub directional couplers of

stubs with a rectangular cross section, in which the size of the wide waveguide
face is larger than the size of the wide face of the coupled waveguides, makes it
possible to decrease the change of their transient attenuation characteristics
in the working range of wavelengths. The effect of an increase of the size of
the wide face of stubs of H-shaped (II) cross section on the transfer character-
istics of the directional coupler is considered. The drawing of a cross section
in a horizontal plane of symmetry of a section of a stub directional coupler
with H-shape stubs is discussed. An equivalent circuit with certain omissions
is presented in order to determine the critical wavelengths of a waveguide con-
nection (stub). The experimental investigation of the stub couplers with wave-
guide connections completely confirms the theoretical conclusions. Figures 2;
references: 2 Russian.
[331-6415]

RING-SHAPED DIRECTIONAL COUPLERS

SITNYANSKIY, B. D.

[Abstract] A ring-shaped directional coupler of a general form which has one
plane of symmetry is presented. Using the symmetry of the device and the
accomplishing superposition of auxiliary regimes of simultaneous cophased and
antiphase excitation on the part of two of the inputs (1 and 3), expressions
are obtained for elements of the scattering matrix of an eight-pole. The
parameters of certain schemes of ring bridges and couplers are listed in a
table. The elements of the scattering matrix of ring-shaped schemes in a fre-
quency band are computed simply on a computer with the assistance of the "Skhema"
program for analysis of microwave devices. The computations were fulfilled on
an YeS-1020 computer. A figure shows curves for the values $|s_{11}|$ and $|s_{14}|$
which characterize an agreement and decoupling of several ring-shaped schemes.
The number of curves in the figure correspond to the number of schemes in the
table. Figures 2; tables 1; references: 2 Russian.
[331-6415]

SYNTHESIS OF DIRECTIONAL COUPLERS WITH FIXED PHASE DIFFERENCE BETWEEN OUTPUT
SIGNALS

SLEDKOV, V. A.

[Abstract] The synthesis of a wideband directional coupler with a fixed phase
difference ψ_0 between the output signals and a fixed ratio M of their ampli-
tudes is shown, a synthesis of the basis of n coupled stepping lines. The method
of design is based on representing the two parts (real and imaginary) of the
$T_{21} = Re(T) + jIm(T)$ function of the equivalent fourpole network in the synphasal
excitation mode as a series of cosine terms and sine terms, respectively. The
coefficients in each series are calculated separately, with the use of the "error
curve", and they yield the design parameters as well as the characteristic im-
pedance and the crosstalk attenuation at a given wavelength. Numerical values
are shown tabulated for M = 1 and for any M, also the resulting synthesis of an
asymmetric directional coupler with a compensating segment of a homogeneous line
and of a symmetric directional coupler with a compensating segment of a homogene-
ous line. Figures 2; tables 2; references 8: 3 Russian, 5 Western.
[365-2415]

EXTERNAL PARAMETERS OF 16-POLE WAVEGUIDE BRIDGE

SKRYPNIK, L. V.

[Abstract] This brief communication considers a waveguide bridge of 16 poles
which is intended for directed distribution of microwave power to four equal
parts. It contains four waveguide inputs, fulfilled in the form of adjacent
regions of the overall waveguide, and four of the same type waveguide outputs.
The input and output waveguides are supplied from the ends of a hollow rectangu-
lar waveguide with cross sections 2a x 2b and a length of 2l. The merit of such
a device is the simplicity of construction, compactness and increased electric
strength. It can be used, in particular, for the power supply of monopulse
antennas and elements of antenna arrays. The properties of the bridge are con-
sidered in a 1977 paper by Skrypnik. The methods and results of computation of
its external parameters are considered here. The experimental investigation
conducted in the 4-cm band of wavelengths with a width of 7% confirms the

calculated parameters of the bridge sufficiently well. Certain additional
changes will improve the bridge. Figures 3; tables 1; references: 3 Russian.
[331-6415]

FERRITE FILTER SYNTHESIS

AVERIN, A. N., ROGOZIN, V. V. and FEL'DSHTEYN, A. L.

[Abstract] The operative concepts in classical microwave filter design theory
are the internal and external quality factors. This paper utilizes these con-
cepts in a classical analysis of ferrite filters designed around orthogonal
transmission lines; it is assumed that the length of the coupling lines is
arbitrary. By solving the field problem of a single section ferrite filter and
using the Q concepts, a transfer function matrix is derived which matches the
transfer function matrix of the filter prototype using lumped elements, taken as
the basis for the synthesis of such microwave filters. The applicability of
these methods developed for microwave filters with transmission line sections
is illustrated with a two-section ferrite filter, assuming that the load elements
forming its transmission lines are zero elements. An expression is derived for
the working attenuation function and by specifying the permissible nonuniformity
of the frequency response within the passband, as well as the coupling line
lengths, the values of the asymmetry factor and the external Q's of the filter
networks are obtained. It is noted that if the sections are asymmetrical, the
coupling lines are of arbitrary length and the load elements are nonzero, but
small, then a filter can still be synthesized by drawing on the field theory for
ferrite filters to calculate the asymmetry factors, the transformation ratios
of the ferrites, taking the load elements into account, etc. A design example
of a ferrite filter with quarter-wave coupling lines has the following param-
eters: maximally flat filter response with a 3 dB bandwidth of 64 MHz and a
stopband at the 30 dB level of 350 MHz; a two section filter with a Q of 44.6
and external Q's of 31.5 for the sections can accomplish this. The diameter
of a turn for the case of loop coupling of the ferrites to the transmission
lines is 0.9 mm, where the IZhG type ferrite diameter is 0.5 mm. If the
spacing between the sections is reduced to 5 mm, the same frequency response
can be obtained by increasing the coupling line turn diameter to 1.6 mm.
Figures 2; references: 9 Russian.
[334-8225]

BROADBAND RADIO FREQUENCY TRANSFORMERS

LONDON, S. Ye. and TOMASHEVICH, S. V.

[Abstract] Three major parameters of broadband RF transformers are used in an extensive review of the performance and equivalent circuits of such transformers: voltage transformation ratio, n; ratio of the high to low frequency, a; and the mismatch factor, s. Broadband transformers using transmission line sections can be designed for both integer and fractional values of n. The drawbacks to such RF transformers with windings of matched two-conductor lines (the much greater total length of the conductors on the core, the presence of additional phase compensating lines which do not participate in producing the shunting inductance and difficulties in the realization of fractional values of n) can be circumvented by using multiconductor transmission lines. The optimal struc-ture of such transformers is distinguished by the fact that the turns which form the windings are oriented relative to each other so as to form a multiple conductor line with a specified range of frequency parameters, which are responsi-ble for the theoretically zero mismatch; these devices have the maximum working bandwidth and the equivalent circuit is in turn equivalent at the upper fre-quencies to a crossed zero attenuation network with a nonlinear phase-frequency response in the general case, which depends on the variant selected for the wave conductance matrices of the line sections. Such transformers have a wide frequency range, are compact and extend frequency coverage up through the microwave band, while sustaining higher power levels. The in-depth theoretical treatment is a survey of the state of the art in such RF transformer design, though no specific data are given on Soviet designs. Figures 24; references 76: 33 Russian, 43 Western.
[334-8225]

RESONATOR WITH MULTIPLE ANTIRESONANCE FREQUENCIES

KOZLOVSKIY, V. V.

[Abstract] A microwave resonator consisting of long-line segments is described in which parasitic harmonics in the oscillation spectrum of the output signal are suppressed by antiresonance. The input impedance of such a line is calcu-lated which will theoretically yield a zero filtration coefficient at all harmonic frequencies; its characteristic impedance is also calculated. A typical 3 GHz line loaded by a 50Ω resistive load will suppress the second

harmonic (6 GHz) by 75 dB and the third harmonic (9 GHz) by 83 dB. Figures 1; references: 2 Russian.
[365-2415]

FIBER-OPTICAL REFLECTOMETER

BORODULIN, V. I., VLASOV, V. A., GULYAYEV, Yu. V., KONYAYEV, V. P.,
KULYMANOV, A. V., POTAPOV, V. T., SOSNIN, V. P., TAUBKIN, I. I., TIMOFEYEV, A. A.,
SHVEYKIN, V. I. and ELENKRIG, B. B.

[Abstract] The method of optical reflectometry in the time domain is widely
used during investigation of the properties of light guides. This method, based
on measurement of the dependence of a backscattered signal in the light guide
on time, makes it possible to investigate the dependence of the attenuation
of light in the light guide on its length as well as to determine the causes
of radiated power in the section of the light guide under investigation. The
experimental installations which possess the high characteristics described in
the literature, nevertheless remain laboratory installations in view of their
awkwardness.   Recently, advertisements have appeared from foreign firms con-
cerned with the development of devices--reflectometers based on the experimental
installations. In the present paper, the authors have as their goal the develop-
ment and creation of a Soviet reflectometer--a device which has parameters close
to the parameters of laboratory experimental installations, but suitable also for
operation under both conditions of operational fiber-optical lines and during
production of optical fibers and cables. The reflectometer discussed is com-
pletely fulfilled on the basis of semiconductor elements. As a source of radia-
tion an injection laser was used, based on a double heterostructure $Al_xGa_{1-x}As$
with an active region ~ 0.6 micrometer thick, radiating in the 0.8-0.9 micrometer
wave band. Use of a laser with these parameters makes it possible to introduce
up to 150 mW radiation power into a Type "Gradan" fiber light guide with a
diameter of the light-conducting strand of 60 micrometer and a numerical aperture
~ 0.18 at a wave length $\lambda = 0.85$ micrometer. The duration of the radiation pulse
amounts to 30 nanosecond and the recurrence frequency to 10 kHz. A fiber-
optical directional coupler and a photodetector based on an avalanche photo-
diode are used. A block diagram of the photodetector and its principal param-
eters are presented. The reflectometer described makes it possible to measure
with a sufficiently high precision the dependence of the losses of light power
on the length of the fiber, both under laboratory conditions and under conditions
of use and production of light guides. It is also shown that the reflectometer
described can be used for investigation of the mechanism of losses in light
guides, including Rayleigh scattering, as well as for the creation of sensitive
transducers of various physical magnitudes, the principles of operation of which

are based on change of the conditions of reflection of light at the boundary of the light guide with the presence of external influences. Figures 4; references 4: 2 Russian, 2 Western.
[328-6415]

PECULIARITIES OF EXCITATION AND POLARIZATION EFFECTS IN GRADIENTAL LIGHT GUIDES WITH M-TYPE Δn PROFILE

DEDLOVSKIY, M. M. and KORSHUNOV, I. P.

[Abstract] An experimental study was made to estimate the peculiarities of excitation in a multimode gradiental light guide with an M-type Δn profile. Such a "Gradan" light guide approximately 4 m long with a conductor 60 micrometer in diameter was excited by the appropriate component of a circularly polarized Gaussian light beam coming from a He-Ne laser through a quarter-wave plate and a polaroid. The optimum excitation was found to correspond to a light beam propagating symmetrically with respect to any half of the 2-hump Δn profile. The polarization at the exit was found to depend on the polarization at the entrance, varying between an almost linear one and an almost circular one during rotation of the polarization axis at the entrance through a 45° angle. This phenomenon is attributable to an elliptical cross section of the light guide, which also cause the axes of elliptical polarization to turn around as the light guide is twisted about its axis. This trend was found to continue through a twist of 180°. Further twisting produced stresses and changes in the excitation conditions at the entrance. Figures 4; references 3: 2 Russian, 1 Western.
[336-2415]

EXPERIMENTAL INVESTIGATION OF FIELD IN NONSYMMETRICAL STRIP LINES WITH HELP OF GYROMAGNETIC RESONATOR

POLUKHIN, Yu. N., GALDINA, N. M. and BROVYAKOV, V. P.

[Abstract] The authors consider the methods and results of an experimental investigation of the coordinate distribution of the components of a magnetic field in a nonsymmetrical strip line (NSL). The investigation is conducted by the method of a test body, as which a specimen of a monocrystalline

ferrite-geomagnetic resonator (GR) is used. Introduction of the GR into the transmission line leads to a resonance perturbation of the field of the line. Information concerning a nonperturbated field put into this perturbation can be registered by measurement of the exterior parameters of the charged resonance system (lines with GR) and in particular, the resonance values of the elements of the scattering matrix $S_{ij}P$ (i,j = 1,2). In the present work, methods are used, free from the errors found in the literature, which make possible an investigation of NSL with a solid-state substrate in order to obtain more reliable results. A model of NSL with a liquid dielectric is also investigated which makes it possible to obtain the field distribution, not only above the substrate but within it. An algorithm is derived for processing the experimental data from the work. A comparison shows agreement of the basic characteristics of the theoretical and experimental distribution of the fields. Figures 4; references 4: 2 Russian, 2 Western.
[328-6415]

CORRECTIVE FEEDBACK NETWORKS IN AUTONOMOUS VOLTAGE INVERTERS

CHAPLYGIN, YEVGENIY YEVGENYEVICH, candidate of technical sciences, dotsent,
Moscow Power Engineering Institute

[Abstract] Conventional means alone are either too complex or too inadequate
for controlling the output waveform of autonomous voltage inverters in a.c.
power supplies. Selective elimination of low-order harmonics by means of
additional switching at half-periods requires special equipment, and pulse-
width modulation of the output voltage does not completely suppress all harmonics
within the ω_0-ω_c band (ω_0—inverter output frequency, ω_c—filter cutoff frequency).
Corrective feedback is simple and provides adequate suppression. A corrective
feedback network consists of selective or low-pass filters which feed the low-
order harmonics to the control circuit for regulation of the inverter switching
angles in the open loop and to a feedback converter generating a corrective
voltage in the closed loop. Here the performance of such a system is analyzed
by the method of small increments, considering, for simplicity, a symmetric
autonomous voltage inverter with only odd sine components in the output voltage.
Even sine components and cosine components can be calculated analogously. This
method of analysis, applied specifically to corrective feedback with pulse-width
modulation, yields not only the harmonic content of the output voltage but also
reveals the effect of various destablizing factors for design purposes.
Figures 2; tables 3; references 6: 5 Russian, 1 Western.
[366-2415]

START-STOP TIME-TO-AMPLITUDE CONVERTER WITH HIGH PERMISSIBLE COUNTING RATE

DEGTYAREV, A. P., MAKHRINSKIY, T. V. and SHEVCHENKO, V. A., Kiev State University

[Abstract] A time-to-amplitude converter is described, which has in spite of
the large range of conversion, a high channel load and a high long-duration
stability. The logical part of the converter is fulfilled by K155LAZ micro-
circuits which make it simple in execution and reliable in operation. A block
diagram and functional circuit of the device are presented, the START and STOP
channels of which contain bandpass filters which assure a selection of concurrent
events as well as blocking of channels at the time of measurement. The range
of the converter is 350 nanosecond. The converter described operated for a
long time in the composition of a neutron spectrometer. The authors thank
Ye. A. Andreyev, V. K. Basenko and M. I. Skopyuk for assistance in the work.
Figures 2; references: 2 Russian.
[320-6415]

INTEGRATING CONVERTER OF VOLTAGE AND CURRENT INTO INTERVAL OF TIME

ANDREYEV, A. B., KRYSIN, Yu. M. and FROLOV, V. M.

[Abstract] An integrating converter of voltage and current into an interval
of time (ICVCT) is described, which is free from the shortcomings of similar
converters described in the literature. Eliminating the shunting effect of the
second integrator is achieved by the introduction of a differentiator. A
functional circuit and the principal circuit of the ICVCT are presented and
explained. The circuit of the converter does not require complex adjustment.
The device was used in a semiautomatic stand for measuring the parameters of
semiconductor low-power diodes and stabilizer diodes. During tests of a number
of experimental-industrial specimens of the converter, the following technical
characteristics were obtained: limits of voltage conversion, 3.30 V; limits
of current conversion, 3, 30, 300 microamperes; conversion time in any regime,
40 ms; input resistance of direct current in a regime of voltage measurement,
> 1 Ohm; in a regime of current measurement < 2 ohm; reduced error of converter
at any limit in the range of temperature of environment of 10 ÷ 35°C, not more
than 0.05%. Figures 2; references: 3 Russian.
[320-6415]

HIGH-SPEED PARALLEL-SERIES ANALOG-TO-DIGITAL CONVERTER

GORSHKOV, A. P. and KRYLOV, I. K.

[Abstract] A 6-digit parallel-series analog-to-digital converter (ADC) with
closed cycle coding is described. A functional diagram of the overall converter
is presented. In order to assure operation of the ADC with rapidly fluctuating
(wide-band) signals at the input of the converter, a wide-band device for read-
out and storage (DRS) is included. The device accomplishes read-out and storage
with the necessary precision at the time of coding the instantaneous value of
the input signal of the ADC. The DRS was used in an experimental model. This
device assured read-out and storage of the instantaneous values of a video
signal which has a spectrum width up to 20 MHz with an error $\leq 1\%$ and a storage
time ≥ 1 microsecond. In order to code the values of signals with a wider width
of the spectrum in the ADC, it is necessary to use a higher speed DRS. Schematic
diagrams are shown of the following ADC components: comparator, thermocompensa-
tion of a generator with transistorized switches, source of reference voltages,
coder and output register and device for control and synchronization. Data on
each item are presented. Figures 7; references: 4 Russian.
[320-6415]

MICROELECTRONIC ANALOG-DIGITAL CONVERTER WITH LOW POWER REQUIREMENT

BOCHAROV, Yu. I., LEBEDEV, A. A. and STEPANENKO, I. P.

[Abstract] In order to construct a system for collection and transfer of analog
information in the composition of a device with autonomous power supply, it is
necessary to use an analog-digital converter (ADC) with a minimum power require-
ment. Series manufactured ADC require a power of more than 0.5 W. The present
brief communication considers the circuit of an ADC with a power requirement
less than 100 mW, based on micropower integrated circuits of series 140, 564
and 572. The block diagram of an ADC which was developed with a word length of
10 bits is presented and explained. In the ADC a method is used of converting
voltage into frequency with rough and precise quantization. A block diagram is
shown of a delta-sigma modulator which is used for this conversion. Construc-
tion of the ADC is fulfilled with two 110 x 170 mm printed boards. On one of

the boards the analog unit of the ADC is laid out, and on the other the digital. The parameters of the developed ADC are shown in a table. A comparison of the parameters of the developed ADC with the parameters of series converters makes it possible to conclude that the developed circuit is characterized by the smaller power requirement. Figures 2; tables 1; references 3: 1 Russian, 2 Western. [339-6415]

NOISE IMMUNITY OF CONVERTERS OF PULSES FOR MATCHING WITH INPUT OF MULTICHANNEL AMPLITUDE ANALYZER

BALYKIN, A. V., BABKIN, A. F., POTAPOV, O. G. and YAGUNOV, A. S., Central Scientific Research Institute of Roentgenology and Radiology, Leningrad

[Abstract] For selection of the extreme values of voltage and, in particular, pulses, a number of converters are known. Their operation is based on charging a capacitor through a nonlinear element and the subsequent read-out of information. Devices fulfilled on the basis of a nonlinear operational amplifier are optimum, the use of which assures a high speed of response and precision of conversion. However, in high noise conditions their use is difficult because of the possibility of an instantaneous false response from an individual pulse. In order to increase the noise immunity, the authors developed a two-threshold converter, a block diagram and an operational diagram of which are presented. An investigation of the efficiency of the converter during feeding at its input of signals of various durations and amplitudes shows that the device assures stability of conversion of pulses with a bell-shaped form with a duration of $15 \div 200$ microseconds and an amplitude of $50 \div 1500$ mV into a rectangular shape. The output signal is positive with a duration of 4 microseconds with fronts <0.5 microsecond. The precision of conversion is better than 1%. The converter has been successfully used for conversion of signals in a pulse flow-type cytofluorimeter. Figures 2; references: 5 Russian. [320-6415]

PRINCIPLES OF DESIGNING INTEGRATING ANALOG CONVERTERS ON BASIS OF CAPILLARY
MERCURY/ELECTROLYTE CELLS

KAZARYAN, E. V., candidate of technical sciences

[Abstract] The design and the performance of integrating analog converters
consisting of capillary mercury-electrolyte cells are analyzed, such devices
being particularly suitable for large integration intervals ($t_1 > 10^5$-10^7 s or
500-1000 h). They operate on the electrochemical concentration-cell principle
with mass transfer, a basic cell constituting a hermetic chamber filled with an
electrolyte and several capillaries inside, which are filled partly with this
electrolyte and partly with mercury. One capillary serves as the counting
electrode, the others serve as control electrodes. Capillaries with a uniform
cross section yield a linear conversion characteristic, while capillaries with
a cross section varying over the length yield corresponding nonlinear conversion
characteristics. An integrating analog converter of this type can be regarded
essentially as a controllable resistor, with the appropriate transfer function
characterizing it as an integrator of continuous signals or an integrator of
pulse signals. It is more accurate and stable as well as more reliable and
economical than electromechanical, electrical resistive-capacitive, thermo-
electric, magnetic, pneumatic and hydraulic devices for the same purpose. Its
major applications include ensuring the required sequence of variable time
intervals in a cyclic technological process, recording the length of operation
of equipment, and determining the total diurnal dose of incident solar
radiation. Figures 8; tables 3; references 18: 16 Russian, 2 Western.
[371-2415]

CRYOGENICS AND SUPERCONDUCTIVITY

INVESTIGATING PMT-3 MICROHARDNESS TESTER TO OBTAIN JOSEPHSON MICROBRIDGES

LATYSHEV, Yu. I., Institute of Radio Engineering and Electronics,
USSR Academy of Sciences, Moscow

[Abstract] A method is described for obtaining Josephson microbridges with the
aid of an industrial device, the PMT-3 microhardness tester. This tester is
provided with a diamond pyramid with a radius of curvature of 1 micrometer and
a vertex angle of 136°, which is used as a cutter for obtaining narrow flutes
on a crystalline quartz substrate. A superconductor film (ordinarily tin is
used) with a thickness of $1 \div 1.5$ micrometer is deposited on the substrate. The
microhardness tester makes it possible to regulate precisely the load on the
pyramid from fractions to hundreds of grams. The pyramid under a load moves
in a direction parallel to the diagonal of its foundation with the aid of the
thin micrometer feed of the hardness tester. Typical bridges obtained by the
method described have the following dimensions: length $\lesssim$ 0.5 micrometer;
width $\lesssim$ 1 micrometer; thickness, $200 \div 1000$ Å; and a resistance at 4.2 K from
0.1 to 1 ohm. These bridges clearly displayed the Josephson properties. The
author thanks F. Ya. Nadya for reading the manusrript of the paper and for
valuable remarks. Figures 2; references 8: 5 Russian, 3 Western.
[320-6415]

DYNAMIC AND FLUCTUATION PARAMETERS OF DIRECT-CURRENT SQUIDS

DANILOV, V. V. and LIKHAREV, K. K.

[Abstract] In a 1980 paper by the authors, an overall analysis is made of the
dynamic and fluctuation parameters of radio frequency superconducting quantum
interferometric devices (SQUID). Recently, more and more use has been found
for another type of such devices--the two-contact SQUID (or the "direct-current"
SQUID). It was with the aid of such SQUIDs that recently record-breaking values
were obtained for the sensitivity--to 3.10^{-33} Joule/Hertz with respect to energy,
i.e., to 2.10^{-10} K/Hz with respect to temperature. Up to now the theoretical
analysis of such devices, conducted by analytical and numerical methods, did not
include consideration of important problems concerning the reverse effect of a
SQUID on the input circuits. In the present work, the authors give a detailed
analysis of the parameters of direct-current SQUIDs with particular attention
to calculation of the fluctuation and dynamic effect on the input. As usual,
a resistive model of Josephson contacts is used. It is shown that within the
limits of a resistance model of a Josephson contacts it is possible to find
analytically all the signal and noise parameters of a two-contact SQUID with
large and small values of the basic parameter of the SQUID, $1 = 2\pi LI_{c\Sigma}/\phi_0$. These
results, together with the results obtained in the previous work by Danilov and
Likharev for one-contact SQUIDs makes possible conducting sequential analysis
of the threshold sensitivity of SQUIDs in those conditions when their effect on
the source of a measurable signal is substantial. Figures 2; references 9:
6 Russian, 3 Western.
[328-6415]

MEASURING MAGNETIC SUSCEPTIBILITY USING SUPERCONDUCTING QUANTUM MAGNETOMETER

ALEKSEYEV, N. I. and KUZNETSOV, V. D.

[Abstract] The paper describes the design and principles of operation of a
superconducting quantum magnetometer for measurement of magnetic susceptability
and magnetic anisotropy. A detailed schematic drawing of the magnetometer is
presented. The principles of operation of the devices are based on two
phenomena: quantization of the magnetic flux and Josephson tunneling through
the "weak unit" in the superconducting quantum interference device (SQUID).
The device, assembled in a cryostat with a 1 liter capacity, is sensitive to a

change of the magnetic flux, produced by a specimen which is placed in a stable
uniform magnetic field. Change of the flux is recorded by a superconducting
transformer flux, which consists of two receiving coils wound in opposite direc-
tions, and the signal coil is inductively connected with the superconducting
transducers of magnetic flux. Measurements of the magnetic susceptibility of
various materials were made on the magnetometer at a vaporization temperature
of liquid helium in magnetizing fields from 0 to 50 mTesla amounts to 0.02
quantum per minute. With an increase of the field, the noise increases. The
causes of this are described. A figure shows the change of the magnetic moment
of the specimen of pyrolytic boron nitride as a function of the magnetizing of
the field. The values of the magnetic susceptibility obtained show that
pyrolytic boron nitride is a diamagnetic material without any paramagnetic and
ferromagnetic addition, with clearly expressed magnetic anisotropy resulting
from the structure of the same material. The paper was recommended by the Moscow
Chemical-Technological Institute imeni D. I. Mendeleyev. Figures 4; references
10: 4 Russian, 6 Western.
[348-6415]

EFFECT OF PARAMETERS OF MULTICIRCUIT SYSTEM WITH SUPERCONDUCTING RESONATOR ON
STABILITY OF OSCILLATOR FREQUENCIES

ZUBIYETOV, P. I., MINAKOVA, I. I., MININA, G. P. and PANOV, V. I.

[Abstract] Highly stable microwave oscillators which are stabilized by a
superconducting resonator can serve as a secondary frequency standard and compete
with respect to stability with quantum standards. As shown in a 1976 work in
which a number of the authors of the present paper participated, the most
promising method of frequency stabilization, which makes it possible simultaneously
to narrow the natural width of the line of oscillations of a microwave oscillator,
is the use of frequency pulling of the oscillator by the superconducting resonator
of a three-circuit scheme. The frequency stabilization system comprises three
series-connected resonators. A theoretical and experimental study is made of
this three-resonator system. On the basis of an analysis of the results obtained,
the authors are able to draw conclusions concerning the nature of the dependences
of the stabilization parameters on the adjustments, and to establish limits of
permissible adjustments during the creation of highly-stable one-channel oscil-
lators with a superconducting resonator. Specifically, it is concluded:
1) The magnitude of the adjustment ξ_2 of the frequency of the intermediate
resonator and the superconducting resonator determine the nature of the persis-
tance and change of the form of the frequency curve; 2) The presence of adjust-
ment ξ_2 can lead to an increase of the maximum stabilization factor at the middle
branch; 3) The analytical dependence of the conditions of stability on $\xi_2 \neq 0$ is
obtained for a system with a large margin of regeneration; and 4) The experiment

quantitatively agrees with the calculated dependences. Figures 5;
references 8: 5 Russian, 3 Western.
[339-6415]

MUTUAL SYNCHRONIZATION OF JOSEPHSON JUNCTIONS

KUZ'MIN, L. S., LIKHAREV, K. K. and OVSYANNIKOV, G. A.

[Abstract] Synchronization of processes in two electrodynamically coupled
Josephson junctions is analyzed theoretically by the method of slowly varying
amplitudes. The most interesting case is that of a low-capacitance junction
pair, which can be described by the conventional resistance model. First two
identical or almost identical such junctions are considered, coupled through
a linear element which does not pass a direct current but has a finite complex
conductance at frequencies of the order of the Josephson generation frequencies.
Fundamental relations are established for the current through and the voltage
across this coupling element, taking into account fluctuations of the junction
voltages. The width of the synchronization range is determined for the specific
case of two junctions connected in series with respect to the d.c. current.
When the two junctions are sufficiently nonidentical, then synchronization can
also occur with a purely resistive coupling element. When the coupling element
has also a complex conductance at low frequencies, then both junctions are in
effect additionally coupled with respect to the d.c. current. The authors
thank V. V. Migulin for the many valuable comments. Figures 3; references 16:
4 Russian, 12 Western.
[336-2415]

SUPERCONDUCTING ELEMENTARY ANTENNAS

PAVLYUK, V. A. and KRIVOSHEYEV, Ye. F.

[Abstract] The performance characteristics of superconducting small elementary
antennas are evaluated on the basis of theoretical relations and experimental
data. Higher gain, Q-factor, efficiency, sensitivity and radiation power are
attainable by virtue of low Joule-effect losses and high permissible current
densities. Contributing factors are the Josephson effects and quantization of

the magnetic flux in the superconducting state. Further improvements in the performance of receivers with a closed path for the superconduction current component can be made by inclusion of a quantum interfer mometer, which will fix the changes in the electric current within the $\Delta I = 10^{-11}-10^{-10}$ $A/\sqrt{Hz}$ range. Another method of improving the performance of small antennas is cryogenic cooling, with liquid hydrogen (20 K) or liquid nitrogen (77 K), which not only decreases the thermal losses in the conductor and increases the electric strength of the metal such as pure aluminum but also lowers the intrinsic noise temperature. Experimental data for this study were obtained with a multiturn loop antenna and an asymmetric pin radiator. The authors thank D. Ya. Bakhrakh for the helpful comments on the results of this study. Figures 3; references 14: 6 Russian, 8 Western.
[336-2415]

ELECTRICAL ENGINEERING EQUIPMENT AND
MACHINERY: APPLICATIONS AND THEORY

ELECTRIC STRENGTH OF IONIZED IRRADIATION OF INTERELECTRODE GAPS

ROZENKRANTS, A. S., candidate of technical sciences

[Abstract] This paper depends to a very considerable extent on a 1970 work
by Rosenkrants in which he presents the results of a study of methods for
calculating nonlinear electrical fields in ionized irradiated gas. The space
charge which appears in an ionized irradiated gas can give rise to a substantial
field distortion: in the layers near an electrode, the voltage is increased,
sometimes twice as much, and in the middle zone it is decreased. Thus, even
among the parallel planes of the electrodes the field becomes nonuniform. Any
increase of the nonuniformity of the field must lead to a reduction of the
electric strength. It can be expected that a noticeable reduction of the break-
down voltages between the electrodes will occur with very considerable powers of
the dose of ionizing radiation, during which with an increase of the interelec-
trode spacing, the required power of irradiation is decreased. A formula is
derived from which it follows that the larger the voltage E_o, the larger is the
power of ionization necessary in order to obtain any specific value M and be-
cause an electric breakdown begins with a high field intensity, then in order
simultaneously to obtain during this a large value of M, a large N_1 [number of
pairs of ions appearing in a unit of volume in a unit of time] is required.
An evaluation shows, for example, that the value M = 10 with α = 0.05 m and
E_o = 2.5 · 10^6 V/m can be attained in air under normal conditions with
$N_1 \approx 1.8 · 10^{15}$ $1/(m^3 · s)$ which corresponds to a power of a dose of irradiation
(approximately 26A. kilogram (10^5 P/sec). Irradiation of such power is now
possible, and with various atomic and thermonuclear energies, radiation techni-
ques and technology, the techniques of experimental work, etc. will ever in-
creasingly develop the need to forecast during planning of installations, opera-
ting with large powers of ionized irradiation, possible changes of parameters,
in particular a decrease of the electric strength of insulating gaps. Calcula-
tions of breakdown voltage of ionized radiation were conducted on a computer.
The problem of electric strength with alternating voltage or with pulse irradia-
tion is not touched upon. It is noted that modeling, although with a much
larger expenditure of machine time, is also possible. Figures 3;
references: 3 Russian.
[359-6415]

STRIKES OF HIGH OBJECTS BY LIGHTNING

ALIZADE, A. A. and MUSAYEV, R. K., Baku

[Abstract] Using the Transcaucasian physico-geographical conditions, an investigation of strikes by lightning of objects of various heights was conducted from 1971 to 1979 at the Azerbaijan Scientific-Research Power Engineering Institute (AzNII energetiki). The controlled objects (approximately 150), consisting of radio-television towers and detached lightning rods, had a height of 20 to 220 m and were located at a height from 25 to 2000 m above sea level. A complex of magnetodetectors for combined measurement of the amplitude of the current of the lightning as well as counters of the head-on impact of the lightning were placed at each object. The specific number of strikes by lightning on objects of various heights are shown in a table as a function of the height of the terrain above sea level during 35 thunderstorm days in a year. An analysis of the data presented in a table shows that with an increase of the height of the object and the height of the terrain above sea level up to 1500 m the specific vulnerability of the objects is increased, which can be explained by the fact that in mountainous conditions, even with objects of low height, ascending discharges can develop. A decrease of the specific vulnerability at a height of 1500-2000 m is connected with a decrease of the thunderstorm duration at this height. The results of the investigations of the vulnerability of objects will help in solving problems of lightning protection. Figures 2; tables 1; references: 2 Russian.
[358-6415]

PLANNING MODIFICATIONS OF EXPLOSIVE-PROTECTED ASYNCHRONOUS MOTORS FOR COAL
AND MINING SECTIONS OF INDUSTRY

VLASOV, V. G., IVANOV, V. L. and YUDIN, N. N., candidates of technical sciences

[Abstract] The paper proposes to classify the operating conditions and performance of mining mechanisms into three categories: normal, heavy and especially heavy conditions of exploitation. The principal machines and mechanisms of dangerously explosive manufacture are broken into four groups: a) Machines and mechanisms of chemical, petro-chemical; petroleum processing; gas and other sectors of industry. These machines and mechanisms have a steady nature of the load with continuous operating conditions with a small number of start-ups per

hour. b) Mining machines and mechanisms with a constant and stable moment of
load with the number of start-ups not more than 10. c) Mining machines and
mechanisms, the moment of load of which has a random nature and depends on many
factors with the number of start-ups from 10 to 250 per hour. d) Mining machines
and mechanisms which are characterized by especially heavy operation with random
and specific overloads, specific and protracted start-up. In connection with
the above classifications, the structure of a series of explosive-protected
asynchronous motors is presented. The electromagnetic and thermal parameters
of asynchronous motors and their quality and reliability in heavy operating
conditions are considered. Tables 4; references: 7 Russian.
[359-6415]

INVESTIGATING ELECTROMAGNETIC PROCESSES DURING TURN-ON OF THYRISTOR SWITCHES
OF POWER HIGH-VOLTAGE CONVERTERS

TARASOV, A. N., engineer, Power Engineering Institute
imeni G. M. Krzhizhanovskiy

[Abstract] A method is developed for calculation of the electromagnetic
processes which occur during turn-on of high-voltage thyristor switches in
high-power high-voltage 6-20 kV converters, with the turn-on time of the
thyristors taken inot account. The effect on the magnitude of overvoltage
resulting from variance of the turn-on time of the thyristors, the parameters
of the converter and the high-voltage thyristor switches themselves is presented.
The following aspects of the analysis are considered: 1) Equivalent circuit of
converter; 2) Simulation of high-voltage thyristor switch (the circuit of a
three-phase converter bridge is presented); 3) Modelling of high-voltage thyristor
switch (the equivalent circuit for calculation of the process of turn-on of a
high-voltage switch in a three-phase bridge is presented); 4) Equation of state
of system; 5) Results of calculations on "Minsk-32" digital computer; 6) Effect
of parameters of divider network; 7) Effect of anode inductance; 8) Effect of
probability distribution of time lag; and 9) Effect of parameters of converter
transformer. It is concluded that in order to obtain a minimum switching over-
voltage during turn-on it is necessary to assure a minimum resistance of the
resistor of the divider network; an increase, however, of the capacitance of the
divider network does not lead to a noticeable reduction of the overpeak of the
voltage at the lagging thyristors. A change of the parameters of the exterior
damping networks has very little effect on the change of overpeak of the voltage.
The inductance of the anode reactor has a substantial influence on the magnitude
of the voltage overpeak at the thyristors during turn-on. An exceptable value
of the overpeak coefficient $K_b \leq 2$ is obtained with induction of the anode
reactor of approximately $(0.05 \div 0.1) L_k$. From the point of view of minimizing
the voltage overpeak in 6-20 kV converters, lumped induction installed in series

in the anode or cathode network of the high-voltage thyristor switches is preferable. Figures 4; references 13: 9 Russian, 4 Western (1 in translation).
[358-6415]

EFFECTIVENESS OF DIVISION OF PULSE VOLTAGES FOR ELEMENTS OF HIGH-VOLTAGE THYRISTOR RECTIFIER WITH DIVIDING BY CAPACITORS AND RC-CIRCUITS

NECHAYEV, O. P., candidate of technical sciences and FEDOTOV, A. I., engineer

[Abstract] The object of this paper is to obtain the dependence of voltage at a rectifier stage, on the parameters of a RC-circuit, or dividing capacitors connected in parallel with the stages. This process is concerned with protection of the high-voltage thyristor rectifiers from pulse effects. The high-voltage thyristor rectifier with division by capacitors as well as with RC-circuits can be represented by a ladder network which consists of N Γ-shaped units. A calculated circuit diagram is presented which shows the dividing capacitors and the RC-circuit. Assumptions made during composition of the diagram are listed. It is shown that a rectifier with a system of dual voltage division, calculated according to the method described, successfully passed a test with a pulse wave which had an amplitude of 190 kV and 1 microsecond front. Figures 5; tables 1; references: 6 Russian.
[359-6415]

ARC EXTINCTION OF ALTERNATING CURRENT BY BLAST THROUGH GAS-PERMEABLE ELECTRODES

AGAFONOV, G. Ye., KRIZHANSKIY, S. M., TARASOV, V. K. and YANOVA, T. V.,
Leningrad Production Association "Electrical Equipment"

[Abstract] The results are presented of investigations of a blast through porous electrodes for extinction of an arc of alternating current, with consideration of the problems of cooling (by compressed gas or by a liquid) of the electrodes. This is done for the most part theoretically, and the effect of a blast through a porous electrode on arc extinction, experimentally. Investigations of a new method of extinction by a blast through electrodes penetrable by gas showed its efficiency and the possibility of implementation. In so doing, the consumption of gas for arc extinction can be considerably reduced, by 5-6 times, and the erosional resistance of contacts is increased, which involves

reduction of the expense of materials and the cost of a switch as a whole, per unit of disconnected power. During a choice of porous electrodes the preference must be given to materials with a high melting temperature with directional pores and with penetrability in the limits 15 to 25 1 (c.cm^2.MPa). The principal problem during development of arc suppression devices with the use of a blast through a porous electrode consists of the development of industrial technology and mass production of porous electrodes of high-melting materials with a high gas penetrability and durability. Figures 2; references: 4 Russian. [358-6415]

REGULATING AND COMPENSATING DEVICES FOR OPTIMUM OPERATION OF EXTRA-HIGH VOLTAGE NETWORKS

KRAYZ, A. G. and MASTRYUKOV, L. A., candidates of technical science, Moscow

[Abstract] The paper discusses static inductive devices which are planned and manufactured at the "Elektrozavod" [Electrical Plant] imeni V. V. Kuybyshev, and intended for operation in networks of high and extra-high voltage as regulating and compensating devices. Shunting reactors and their principal schematic diagrams are presented. A diagram of a shunting reactor for a voltage of 500 and 750 kV is shown and described. It is series produced for power engineering. Compensation reactors are described. The principal circuit is shown of one phase of a static compensator of reactive power, as well as the dimensions of a one-phase compensation reactor of the RKODTs-33333/110 type. Regulating devices are described, which are intended for change of a voltage regime in a network by change of the ratio of transformation by transformers. Figures 4; references 13: 9 Russian, 4 Western. [358-6415]

ELECTROACOUSTICS

CALCULATION OF SCATTERING COEFFICIENTS OF TRANSDUCERS AND EVALUATION OF
REGENERATION EFFECT ON CHARACTERISTICS OF SURFACE ACOUSTIC WAVE DEVICES

NELIN, Ye. A.

[Abstract] The scattering of surface acoustic waves (SAW) by an output
nonapodized transducer, with a decrease of the SAW from the input nonapodized
transducer, is considered in the literature. In the process the amplitude of
the decreasing and reflected (regenerated) waves is constant with respect to
the width of the acoustic beam. In the present work the case is considered
where both transducers are apodized. Here the amplitude of the decreasing wave
changes with respect to the width of the beam in accordance with the function of
apodization of the input transducer, and the reflected of the output transducer.
A way is found to calculate the scattering coefficients of transducers, and an
evaluation is made of the effect of regeneration of the characteristics of SAW
devices. It is shown that the results obtained are a generalization of informa-
tion known earlier, and are found to be in accordance with the results of other
approaches to an analysis of SAW devices. Figures 1; references 12: 4 Russian,
8 Western.
[339-6415]

CALCULATING INFLUENCE OF CERTAIN SECONDARY EFFECTS ON EXPERIMENTAL CHARACTERISTICS OF MATCHED FILTERS FOR PHASE KEYED SIGNALS

KOZLOV, A. S., TOLSTOUKHOV, N. I. and YAKOVKIN, I. B.

[Abstract] The authors consider the influence of certain secondary effects on the performance of passive acoustoelectronic matched filters (MF) for phase shift keyed signals, and evaluate the limit of the attainable parameters of these effects. All the evaluations are made on a one-channel MF based on acoustic surface waves (ASW). The topology of the device is illustrated. Ordinary interdigital transducers (IT) are used. The polarity of the connection of the taps of the middle transducer (in a line of three) determines the types of the phase shift keyed signals. The distance between the electrodes of the two transducers at the ends equals the distance between the taps of the middle transducer. The following items are taken into account: 1) Reflection of ASW from nonuniformities; 2) Dispersion of ASW into space waves and attenuation of ASW during propagation in the IT; 3) Re-emission of ASW; 4) Response of MF characteristics to change of temperature and Doppler effect; and 5) Evaluation of limiting parameter of MF based on ASW. Figures 3; references 8: 3 Russian, 5 Western.
[328-6415]

ELECTROMAGNETIC WAVE PROPAGATION,
ELECTRODYNAMICS

RESTORING CURRENT DISTRIBUTION IN RADIATOR FROM EXPERIMENTAL DATA ON
ELECTROMAGNETIC FIELD INTENSITY IN WAVE-FIELD ZONE

KOROTKOV, V. S. and TURCHIN, V. I.

[Abstract] The reverse problem of determining the radiation source from a known
electromagnetic field distribution is often ill-conditioned and, therefore,
difficult to solve, especially when nonuniform waves excited by fast oscillating
components in the space distribution of sources must be taken into account.
The solution of such a problem is of practical interest, as it relates to the
development of multibeam and phased antenna arrays. Here an approximate smoothed
solution for a linear antenna array is shown and its accuracy is estimated in
terms of current amplitudes and phases determined from field measurements in
the near-field zone. First the general relation between current and electric
field intensity is established for determining the current amplitude-phase
distribution on an arbitrary surface, using the Lorentz lemma, with a straight
line segment and a plane surface area regarded as simple special cases. The
current-amplitude-phase distribution is then simulated on a digital computer,
a one-dimensional equidistant antenna array of 32 elements serving as a typical
example. The authors thank M. A. Miller and N. M. Tseytlin for discussing the
results and offering some good advice, A. L. Fogel', V. A. Antonov, and
I. M. Fortus for assisting with the experiment, and N. V. Veksler, L. R. Semenova
for assisting with the processing of experimental data on the digital computer.
Figures 7; references 9: 6 Russian, 3 Western (two in translation).
[336-2415]

IDEALLY CONDUCTING CURVILINEAR SCREEN IN THE FIELD OF AN H-POLARIZED
ELECTROMAGNETIC WAVE

NAZARCHUK, Z. T.

[Abstract] The two-dimensional stationary problem of diffraction of an
H-polarized electromagnetic wave at an ideally conducting curvilinear
screen is solved with the use of an approach widely applied in the theory
of cracks, and based on straightforward methods for solution of singular
integral equations, which, omitting regularization, lead to the solution
of finite systems of algebraic equations. An algorithm is derived which
makes it possible to conduct a numerical investigation of an electromagnetic
field scattered from cylindrical screens of arbitrary form, excitable by an
arbitrary H-polarized field. Numerical results are given for various screens
in the field of a plane wave. The following directivity patterns are considered:
1) Plane wave scattered at parabolic screen ($\epsilon = 1$); 2) Elliptical screen
($\epsilon = 0.5$); 3) System of "semicircle"-plane wave; and 4) Straight-line screen
in field of plane wave. The dependence of the directivity patterns on the form
of the screen is also shown. Figures 5; references 11: 10 Russian, 1 Western
in translation.
[328-6415]

CHANGE IN SPACE COHERENCE OF FLUCTUATING FIELD CAUSED BY SCATTERING

ZVYAGINTSEV, A. A., SYSOYEV, A. S. and TRET'YAKOV, O. A.

[Abstract] Diffraction of a statistically uniform plane wave by a deterministi-
cally periodic structure in the form of a diffraction grating is considered,
the scattering characteristics of the latter being controllable over a wide
range through variation of its geometrical dimensions. The parameters of a
normally distributed random field are calculated in the case of an arbitrary
random polarization, and in the process a relation is established between the
statistical characteristics of a fluctuating incident field, those of the fluc-
tuating scattered field, and the characteristics of the scatterer. From the
elements of the correlation matrix, in the approximation of a parabolic equation,
longitudinal and transverse correlation radii are obtained for the space harmonics
of the scattered field, these correlation radii decreasing as the order of the
harmonic increases. A numerical analysis reveals a significant effect of

fluctuations on the correlation radii when the angular spectrum of the incident
field is wider than that of the transmitted one. In that case the correlation
function for the transmitted field contains no information about the statistical
parameters of the incident field and is determined principally by the regular
parameters of the diffraction grating. Figures 2; references: 5 Russian.
[365-2415]

MIXED REVERSE ELECTRODYNAMIC PROBLEM OF DIFFRACTION FOR DOUBLY-CONNECTED
SCATTERER

YEROKHIN, G. A. and KOCHERZHEVSKIY, V. G.

[Abstract] The problem of diffraction where the shape of and boundary conditions
at only a part of the scatterer are known is a mixed reverse problem. Here a
plane wave is considered which propagates through a medium with given ϵ, μ (elec-
trical conductivity $\sigma = 0$) and impinges on a scatterer in the x-direction, this
scatterer consisting of two bounded regions homogeneous in the z-direction.
The shape of and the boundary conditions for one are known, the shape of and
the boundary conditions for the other must be determined under given constraints
on the field structure. The general solution is applied to specific problems
such as compensating the field scattered by the first region and reducing the
excitation induced by the second region in the field of the first one. In the
latter case, for specificity, the first region is assumed to be an ideally con-
ducting circular cylinder. The method is easily extendable to multiply-
connected scatterer regions. The numerical calculations were made by
A. A. Ryvlina. Figures 3; references 8: 7 Russian, 1 Western (in translation).
[336-2415]

THEORY OF DIFFRACTION SCREENS

ALIMOVA, L. I., KINBER, B. Ye. and EYDUS, A. G.

[Abstract] The majority of works in the literature concerned with the theory
of screens determine the frequency and space dependences of the screening
factor with a known form of screen. Solutions are written in a Kirchhoff
approximation with a series of simplifying assumptions which ease calculation

of integrals (quadratic approximation for phase and the like). The inverse
problem--determination of the position and form of the screen which assures the
required screening in a specified region of space and a frequency band--is not
considered. A solution of the inverse problem in a limited arrangement is
discussed in one report. However, the form of the screen is determined with
respect to the frequency dependence or screening at only one point of space.
In the present report, the authors obtain a solution to both the primal and the
inverse problem without the above limitation, using the following means:
.) Kirchhoff approximation for a diffraction field; 2) Representation of field
in the form of a Fourier series; 3) Frequently dependence of field in the center
of screened area; and 4) Space structure of field in vicinity of axis. Determina-
tion of the coefficients of expansion $_{nT}$ is conducted in a supplement.
Figures 5; references: 12 Russian.
[328-6415]

DIFFRACTION OF PLANE ELECTROMAGNETIC WAVES ON RADIAL CONDUCTING CONICAL SURFACE

GOSHIN, G. G., KRAVCHENKO, G. G. and MYSHKIN, V. G.

[Abstract] With the assistance of the Kontorovich-Lebedev transform, the authors
obtain a rigorous solution to the problem of diffraction of plane electromagnetic
waves of E- and H-polarization at a radial conducting conical surface $\theta = \gamma$ with
two expressions. These expressions are obtained with two conditions at the apex
of the conical surface, corresponding to whether or not there is a discontinuity
in its line of conductance and differing from one another by a term describing
the TEM waves excitable in the structure under consideration. In the area $\theta > \gamma$
the solution is expressed in elementary functions. The previous field after ex-
clusion of the TEM wave is part of the field of an incident plane wave (TE-wave)
which is not disturbed by the surface in question. In the area $\theta < \gamma$, the re-
flected field, also after exclusion of the (TM wave) which is reflected from the
radial conducting conical surface as from the ideally conducting. In this area,
the solution in elementary functions is expressed only in the special case of
a radial conducting area. In both regions it is possible to represent the
field in the form of a superposition of fields of two types, one of which be-
haves as the field of a plane wave, and the second with $Kr \to \infty$ decreases as
$1/Kr$. In the work a solution is obtained for an E- and H-polarized incident
plane wave. However, by a simple superposition it can be generalized into a
case of arbitrary polarization. The authors are grateful to M. S. Bobrovnikov
and R. P. Starovoytov for helpful remarks during discussions. Figures 1;
references 10: 8 Russian, 2 Western.
[328-6415]

ABSORPTION OF ELECTRICALLY POLARIZED PLANE WAVE BY COMB-LIKE STRUCTURE IN
LAYERED DIELECTRIC MEDIUM

SLEPYAN, G. Ya. and SLEPYAN, A. Ya.

[Abstract] The literature has left uninvestigated energy losses because of
nonideal conductivity of the surface of a periodic structure, although considera-
tion of this range of problems appears most important. In the present paper,
the authors are concerned with calculation of the losses during scattering of
plane electrically polarized waves at a metal nonideally conducting comb-like
structure embedded in a layered dielectric medium. An effective numerical cal-
culating algorithm for this scattering is constructed. The algorithm is approved
in practice, using as an example a two-layer medium the dependences of the power
absorbed by the comb-like structure in a two-layered medium on the angle of
incidence, depth and period of the structure are investigated. Resonant bumps
of absorption are found in the comb-like structure. The results obtained can
find practical use during planning of a number of microwave devices. The
authors are grateful to A. S. Il'inskiy for attention to the work and discussion
of the results. Figures 6; references 10: 8 Russian, 2 Western (1 in translation).
[328-6415]

ANISOTROPY OF REFRACTIVE INDEX NONUNIFORMITY IN ATMOSPHERE

APMAND, N. A., KIBARDINA, I. N. and LOMAKIN, A. N.

[Abstract] Experimental data on the fluctuation of the zenith (incidence)
angle, in the vertical plane, of 7.3 GHz radio waves transmitted through the
atmosphere to earth are evaluated in the approximation of geometrical optics,
assuming the structural parameter to be $s = 1/2$ (i.e., $D < \sqrt{\lambda L}$, where D is the
diameter of the antenna, L is the length of the turbulence path, λ is the wave-
length) and that the dielectric permittivity of the atmosphere decreases
exponentially with higher altitude. A correspondence between the intensity of
zenity-angle fluctuations and the intensity of phase-difference fluctuations
having already been established according to the anisotropic modification of
the Karman model, this evaluation yields for both the summer curve and the
fall-winter-spring curve of fluctuations an anisotropy index $\chi = l_H/l_\perp = 0.075$
for an $l_\perp = 530$ m horizontal scale of nonuniformity of the dielectric
permittivity. Figures 2; tables 1; references 8: 3 Russian, 5 Western.
[365-2415]

PROPAGATION OF RADIO PULSES THROUGH GROUND-LAYER WAVEGUIDE

MARKOV, N. G. and KULIKOV, A. N.

[Abstract] A vertical electric dipole is located at some altitude h_0 above the
spherical surface of the earth, within the ground-layer waveguide, and emits a
narrow-band pulse of duration T at a carrier frequency ω_0. The electromagnetic
field can be described by the Hertz function, which satisfies a zero boundary-
value condition at the ground surface. The equation for this function is, after
a Fourier transformation, reduced to a parabolic equation and the solution to the
latter is expressed through residues in the roots of the characteristic
equation $1 - R_s R_1 = 0$ (R_s and R_1 denote the reflection coefficients at, respec-
tively, the ground surface and the upper boundary where the refractive index
changes abruptly) according to the bilinear model of this waveguide. The pro-
pagation of the pulse through this waveguide within its shadow zone is analyzed,
taking into account the altitudinal variation of the dielectric permittivity of
air. The results of calculations indicate that the duration of the pulse will
either remain constant or increase slightly. Distortion of the pulse envelope
can occur only as a result of the ability of the waveguide to entrap more than
one normal mode. The authors thank G. A. Ponomarev for the many helpful
suggestions and comments. Figures 2; references: 7 Russian.
[365-2415]

SLOW WAVES OF PLANE-PARALLEL WAVEGUIDE FILLED WITH TWO-LAYER STRUCTURE
DIELECTRIC-TRANSVERSE MAGNETIZED SEMICONDUCTOR PLASMA

ZAKHAROV, V. A.

[Abstract] The author analyzes the dispersion relation of low-frequency
($\omega < \omega_p$, ω_p is plasma frequency) slow waves propagating in a plane-parallel
waveguide filled by a two-layer structure dielectric-transverse magnetized
semiconductor plasma (TMSP). The effect is investigated of the magnetic field
and the transverse dimensions of the structure on the dispersion and the dis-
tribution of the fields of these waves. In contrast to works from the literature,
the present paper shows the existence of two resonances of a slow wave in the
structure. One of these resonances occurs in the case of coincidence of the
frequency of the wave ω with the cyclotron frequency ω_c of the carriers in the
plasma and the second at the resonance frequency of the surface wave propagating

at the boundary TMSP-dielectric. It is shown that the dispersion relation and distribution of the fields of fast and slow waves of the structure TMSP-dielectric significantly depends on the parameters of the semiconductor, the magnetic field and the transverse dimensions of the structure. In the case of thick layers of the dielectric and semiconductor existing in the structure, the slow waves are two surface waves propagating, respectively, at the boundary TMSP-dielectric and TMSP-metal. For sufficiently thin layers, the phase velocity of one of the slow waves of the structure obviously depends on the thickness of the layers of the dielectric and semiconductor and decreases with a reduction of the latter. The authors thanks V. Ya. Rayevskiy for assistance during calculations, and I. M. Tsidil'kovskiy and A. B. Davydov for helpful discussions. Figures 4; references 13: 5 Russian, 8 Western.
[328-6415]

CONDITIONS OF SYNCHRONISM IN SYSTEM OF ELECTRON BEAM-TRANSVERSE ELECTROMAGNETIC WAVES

SILIVRA, A. A.

[Abstract] The condition of synchronism in a system of an electron beam and two transverse electromagnetic waves with different Lagrange phases is established on the basis of an interaction mechanism which involves nonlinear combination forces, such forces appearing as a consequence of a nonlinear equation of electron motion in the field of such waves. The resulting condition of synchronism of the electron beam with the electromagnetic waves directly, rather than with the combination forces, is found to be satisfied by four modes of interaction. These interaction modes are characterized by the magnitude of the beam velocity V_0 relative to phase velocities V_1, V_2 of the two waves, namely: 1) $V_1 > V_0$ and $0 < V_2 < V_0$, 2) $0 < V_1 < V_0$ and $V_2 > V_0$, 3) $0 < V_1 < V_0$ and $V_2 < 0$, 4) $V_1 < 0$ and $0 < V_2 < V_0$. Interaction is possible when the waves travel with the beam or in other directions. Particularly interesting is the condition of synchronism in the case of interaction with amplification of waves which have equal or close frequencies but different phase velocities. Another case is that of a relativistic electron beam and, as an example, the equation of motion is solved here for a relativistic electron moving in the field of two waves with circular polarization. All the results of this analysis of synchronism can be extended to a system with any number of interacting waves. The author thanks V. A. Zhurakhovskiy for acting as a consultant on the mathematics of the problem. Figures 1; references: 4 Russian.
[365-2415]

ELECTRON AND ION DEVICES; EMISSION;
GAS-DISCHARGE AND ELECTRON-BEAM DEVICES

ELECTRON BEAM AMPLIFICATION IN SEMIISOLATING GaAs STRUCTURES

ZORIN, Ye. I., KOGAN, V. M. and ABRAMOVA, N. N.

[Abstract] Recently attempts have been made to use GaAs as a semiconductor
target and some of this work is described. A requirement also exists for the
creation of devices which have a small output power, but which possess a high-
speed response and a small energy consumption. For such devices it is necessary
to have semiconductor structures operating with small voltage biases, small dark
current and small unit capacitances, which is impossible to obtain using a low-
impedance material. In the present brief communication, the authors show the
possibility of using semiisolating GaAs doped with chrome as the material for a
target. Investigations are made on layers of semiisolating GaAs with a thick-
ness up to 50 micrometer. These layers were formed by diffusion of chrome into
a low-impedance substrate of n-type GaAs with a carrier concentration of
10^{16} cm^{-3}, an electron type of conductivity and a resistivity of 10^7-10^9 ohm.cm.
The multiplier structures were obtained by deposition on the semiisolating layer
of an aluminum contact with a thickness of ~ 0.1 micrometer. It is concluded
that using semiisolating GaAs doped with chrome makes it possible to obtain a
structure with the same multiplication factor as in the case of nondoped n-type
GaAs, but with a smaller unit capacitance, not depending on bias voltages. In
structures with a thickness up to 50 micrometer, total separation of the genera-
ted carriers proceeds with bias voltages in units of a volt. The dark current
during this amounts to $\sim 10^{-9}$ A/mm^2. Protection of the fringe region of the
structures in question by a filler of silicon dioxide makes them compatible
with the production technology of electrovacuum devices where, with the object
of degassing, heating with a high vacuum up to 400°C is necessary. Figures 2;
references 7: 3 Russian, 4 Western.
[328-6415]

ELECTRON TUBES: ELECTROVACUUM TECHNOLOGY

BRO/DENING RANGE OF APPLICABILITY OF ASYMPTOTIC THEORY FOR O-TYPE ČERENKOV
MICROWAVE DEVICES

KOVALEV, N. F.

[Abstract] The conventional theory of O-type high-frequency devices can be
simplified when any of the following parameters is small: 1) $\beta = v/c \ll 1$,
2) $\gamma^{-1} = \sqrt{1-\beta^2} = mc^2/H \ll 1$, 3) $|\gamma - \gamma_0|/(\gamma_0 - 1) \ll 1$ (v--velocity of electrons,
c--velocity of light, H--energy of electrons, mc^2--quiescent electron energy).
The last condition yields equations valid for any initial electron energy. Here
a theory is sonstructed which, besides being "energy universal", also remains
valid under a softer constraint on the increment of electron energy
$(|\gamma - \gamma_0|/|\gamma_0 - 1|)^4 \ll 1$ corresponding to high-efficiency operation. This
theory is based on a system of two asymptotic equations of electron motion in
the field of a traveling high-frequency wave, from which an expression for the
interaction efficiency (average relative decrement of electron energy caused by
interaction with the high-frequency field) is derived. The limiting cases are
$\gamma_0 \to 1$ and $\gamma_0 \to \infty$ corresponding respectively to weak-relativisitc and ultra-
relativisitc motion of electrons. The general case $1 < \gamma_0 < \infty$ is considered next
and here the efficiency is calculated in terms of the envelope of particular
similarity relations, after the entire range has been subdivided into small
intervals to each of which the asymptotic equations of motion and local similarity
relations apply. The author thanks M. I. Petelin for his attentiveness and
continuous interest in this study. References: 1 Russian.
[365-2415]

GENERATING OSCILLATIONS IN OROTRON WITH CROSSED FIELDS

TSEYTLIN, M. B., YEVDOKIMOV, V. V., BERNASHEVSKIY, G. A. and RUSIN, F. S.

[Abstract] A millimeter-wave orotron with crossed fields is considered. The
efficiency of the electron beam imparting its power to the high-frequency field,
the efficiency of conversion of the electron potential energy, and the fraction
of electrons precipitating on the reflector grid are calculated as functions of
the distance along the interaction space. The values of system parameters
correspond to an optimum open resonator, in terms of maximum electronic efficiency
of an O-type orotron. The results indicate that this orotron is quite competi-
tive with an analogous O-type device, if the magnetic field intensity is in-
creased to ensure maximum efficiencies. Figures 2; references: 5 Russian.
[336-2415]

LINEAR ANALYTICAL THEORY OF O-TYPE REFLEX OSCILLATOR WITH LONG-RANGE
INTERACTION

SHMAT'KO, A. A.

[Abstract] A linear analytical theory of a transit-time reflex generator of
diffraction radiation is constructed for such a device with a distributed and
thus long-range interaction. The fundamental equations are formulated for a
quasi-natural mode in a "cold" loaded resonator cavity with a periodic structure,
with the amplitude and the frequency not necessarily constant in time. The time
of electron transit through the cavity in one direction is assumed to be much
shorter than the time of oscillation buildup. From these equations the condi-
tions of self-excitation are determined, in terms of amplitudes and phases of
forward and backward convection currents, taking into account nonlinear varia-
tion of the potential within the range of the retarding field. Then the incre-
ment of oscillation buildup and the electron shift of the oscillation frequency
are calculated, whereupon the starting performance of such a device is analyzed
on this basis for the case of a Gaussian field distribution. Three typical
modes of operation are considered: 1) plain transit, 2) transit with preliminary
modulation of the electron beam, 3) transit-reflection without preliminary
modulation of the electron beam at the entrance but acutally combining modes
1) and 2). Figures 4; references 11: 9 Russian, 2 Western (one in translation).
[365-2415]

THEORETICAL ANALYSIS OF AMPLIFICATION OF STOCHASTIC SIGNALS IN O-TYPE
TRAVELING-WAVE TUBE

ZHELEZOVSKIY, Ye. Ye.

[Abstract] Earlier theoretical analyses of the amplification of stochastic
signals in an O-type traveling-wave tube are supplemented here by calculations
of the amplitude characteristics, the spectral characteristics, and the statisti-
cal parameters of the output signals. These calculations, based on a computer-
aided numerical solution of the appropriate nonlinear equations, reveal a depen-
dence of all on the width of the input signal spectrum as well as on the param-
eters of the retarding system. The coupling impedance is assumed to vary with
frequency according to an already experimentally established law, rather than
to remain constant within the given band. The input signal is represented in
the form of an equidistant spectrum within the given band analogous to a "white"
band noise, which can be produced by modulation or directly by a microwave noise
generator, with the phases of the components taken from a set of random numbers
uniformly distributed over the $[-\pi, \pi]$ interval and their amplitudes taken from
a set of Rayleigh random numbers. Passage of such a stochastic signal through an
O-type traveling-wave tube is found to limit the peaks of the high-frequency
voltage and to alter the statistical distribution so as to reduce the excess,
thus increasing the output power and the efficiency of the amplifier. Passage
with a narrow-band noise does not significantly alter the spectral characteris-
tic of the stochastic input signal when the amplifier operates in the linear
mode or in a slightly nonlinear mode, while passage with a wideband noise dis-
torts it, but passage through an amplifier operating in a highly nonlinear mode
will widen it appreciably. Figures 5; references 7: 6 Russian, 1 Western.
[365-2415]

EXPERIMENTAL STUDY OF CHANGES IN SHAPE AND SIZE OF ELECTRON CLOUD IN
LENTICULAR MAGNETRON TETRODE

LEVIN, G. Ya., ATLASMAN, A. V., VIGDORCHIK, V. I., LOGVINENKO, A. I.,
TEREKHIN, S. N. and SEMENOV, L. A.

[Abstract] A method of measuring the shape and the size of the electron cloud
in a surface-wave magnetron, specifically a millimeter-wave lenticular magnetron
tetrode, is described which can be useful for determining the dynamic

characteristics of such a device or for amplitude and frequency control. The method is based on the fact that the diffusion current flowing to the anode in the cutoff mode of operation depends on the location of the boundary of the electron cloud, namely decreases as the latter moves farther away from the anode. The method, using quiescent probes, was tried out experimentally on an 8-mm magnetron with a solid anode and with two pairs of cylindrical electrodes forming two electrostatic lenses within the interaction space: one near the anode and one near the cathode. With an anode potential of 50 V, natural operating conditions were simulated as closely as possible by maintaining the magnetic field intensity within 15% below critical and by varying the potentials at the two lenses without their magnitude exceeding twice the anode potential. The results indicate how the anode current, the mean current within the center spot of the anode, and the relative distance of the boundary of the electron cloud from the anode depend on the potential at each lens. Increasing the negative potential at the anodic lens was fou..d to compress the electron cloud axially, in the direction of the magnetic field, while increasing the negative potential at the cathodic lens was found to compress the electron cloud radially. Figures 3; references 8: 4 Russian, 4 Western.
[365-2415]

ANALYTICAL MODEL OF SPACE-CHARGE BUILDUP IN MAGNETRON AMPLIFIER

BAYBURIN, V. B.

[Abstract] A magnetron amplifier with an open electron beam operating in the self-modulation mode is considered where the space charge builds up before bombarding the cathode rather than remaining negligibly small. The equations of motion of electrons are solved, assuming that the phase angle of electrons along the cyclo*dal trajectory does not change very much from their emission phase angle. The average values of the two active fields, namely the Coulomb field and the high-frequency signal field, are used in the calculations. Analytical expressions are derived on this basis for the increase of the electron phase angle and impact energy. The space-charge buildup is, furthermore, also estimated on the basis of a simpler model with a negligible Coulomb field. The alternating component of the latter is found to cause shifting of the charge cluster toward the retarding phase of the high-frequency field and of electron bombardment within this region. In a strong space charge, therefore, the range of phases of secondary-electron multiplication in crossed fields is determined principally by the kind of distribution of the Coulomb field and to a lesser degree by the phase of the anodic high-frequency field. Figures 4; references 15: 12 Russian, 3 Western.
[365-2415]

STOCHASTIC OSCILLATION MECHANISM IN VOLTAGE-TUNABLE MAGNETRONS

KAL'YANOV, E. V.

[Abstract] It is shown in the literature that a voltage-tunable magnetron (VTM) intended for generation of a harmonic signal, with increased voltages at the control electrode, operates in a noise mode. On the basis of measurements described in these reports, it is concluded that the cause of the noise spectrum is random jumps at some large speed between π-oscillations and one or several other types of oscillations. At the same time it is noted that on oscillograms of microwave oscillations, it is seen that the signal is amplitude modulated according to the random law and has one filling frequency equal to a frequency of π-form. The latter does not agree with the hypothesis concerning frequency jumps. Refinement of the concept of the mechanism for generating microwave noise in VTM is of interest in connection with the problem of stochastic oscillations in various systems. The present brief communication is devoted to an experimental investigation of this problem. Figure 1 in the test shows curves of the change of power, frequency, anode current and the control electrode current as a function of the ratio of the voltage at the control electrode to its nominal value for a VTM of the decimeter range of wavelengths with a specified voltage at the anode. Figure 2-a shows the change of the spectral density of noise (SDN) at the average frequency of a low-frequency as a function of the ratio of the voltage at the control electrode to its nominal value for various voltages at the anode. Figure 2-b shows the dependence of the SDN on the ratio of the filament current to its nominal value. The investigations conducted point to the fact that stochastic microwave oscillations in VTM with increased voltage at the control electrode is caused by their modulation by the noise of a low-frequency signal and not by random jumps between different types of oscillations.
Figures 3; references 6: 3 Russian, 3 Western.
[328-6415]

AMPLIFYING WIDEBAND SIGNALS IN TRAVELING-WAVE TUBE

BELYAVSKIY, Ye. D.

[Abstract] A method has been developed for calculating the amplification of wideband signals in a traveling-wave tube and analyzing their distortion. The

fundamental system of equations of signal propagation is solved in Lagrange coordinates. After a change to Euler coordinates, the wideband signal is represented as a sum of narrow-band subharmonic ones either spaced or superposed in time and in the latter case interacting at a nonlinearity. An approximate solution is obtained which agrees rather closely with the exact solution even under the most unfavorable conditions. As special cases are considered a wideband input signal consisting of only two narrow-band signals and the interaction of a monochromatic signal and an amplitude-modulated signal with a different mean frequency. Figures 5; references: 5 Russian.
[336-2415]

ENERGY SOURCES

INERTIAL PILE DRIVER TYPE STORAGE DEVICE FOR OBTAINING HIGH-ENERGY ELECTRICAL
PULSES

KUNIN, V. N., DOROZHKOV, V. V. and SERGEYEVA, M. V., Vladimir Polytechnical
Institute

[Abstract] An inertial storage device is described in which the kinetic energy
of a falling electromagnet is converted into the energy of an electric pulse.
The storage device is a system consisting of a direct-current electromagnet
with an armored magnetic core and an operating coil coaxial with it. During
the fall of the electromagnet on to the coil, an electromotive induction force
originates, which is closed up by a low-resistance load. The mass of the de-
vice is 4 metric tons. The maximum fall of the electromagnet with a mass of
1350 kg is 9 meters. A photograph of the overall devices is presented. As
shown by experiment, the dispersion coefficient of the magnetic field amounts
to 1.5 ÷ 1.7. The maximum magnitude of the stored potential energy for the
device in question is ∼ 110 kilojoule. The inertial storage device described
makes it possible to generate pulse current with a bell-shaped form and
energies up to 50 kilojoule and a duration of 50 ÷ 100 msec. Figures 3;
references: 2 Russian.
[320-6415]

INSTRUMENTS, MEASURING DEVICES
AND TESTERS, METHODS OF MEASURING,
GENERAL EXPERIMENTAL TECHNIQUES

GRADIENT NOISE SPECTRUM AT OUTPUT OF LASER DOPPLER FLOW VELOCITY METER

SOBOLEV, V. S., UTKIN, Ye. N. and SHMOYLOV, N. F., Novosibirsk

[Abstract] One of the negative features of a laser doppler velocity meter (LDVM)
is the so-called gradient noise. By "measuring volume" is understood the region
of space from which scattered radiation is received, and in the final analysis
information is obtained concerning the local velocity. In real flows, the
velocity gradient can be extremely significant and the noise produced by it
proves to be commensurate in intensity with the turbulent fluctuations of the
velocity under investigation. In the light of this, the problem arises of an
evaluation of the parameters of gradient noise. In the present communication
the authors analyze one of its basic characteristics--the spectral density of
power. The spectrum is shown of gradient noise obtained during an experimental
investigation of a doppler flow with a constant velocity gradient. The results
of a calculation of the spectral density are included. Figures 2;
references 6: 5 Russian, 1 Western.
[319-6415]

DIFFERENTIAL INTERFEROMETER OF SMALL VOLUME FOR MEASURING ULTRASONIC VELOCITY
AND ABSORPTION

SARVAZYAN, A. P. and KHARAKOZ, D. P., Institute of Biological Physics,
USSR Academy of Sciences, Pushchino

[Abstract] In order to solve many problems connected with the study of inter-
molecular interaction in solutions, precision measurement of ultrasonic velocity

and absorption is necessary in small volumes of liquids ($0.1 \div 1.0$ cm^3). An acoustic resonator interferometer to be used for this purpose is described. The relative error of measurements with connection of the resonator into a circuit with automatic fixation of the amplitude amounts to 10^{-4}% in measuring velocity and 3% in measuring absorption in specimens of liquids with a volume of ~ 0.1 cm^3. The time resolution of the interferometer is on the order of 1 Msecond. The tracking system is explained and the circuit of one of the two autonomous channels of the interferometer is presented. Construction of the acoustic resonator is illustrated and described. The authors are grateful to A. N. Zaikin for helpful discussion of the circuit of the electrical part of the interferometer, and thank A. I. Umnov and I. F. Zayter who fulfilled the most complex technical operations in the preparation of the acoustic resonators. Figures 4; references 5: 4 Russian, 1 Western.
[320-6415]

EFFECT OF LASER RADIATION DISPERSION ON CHARACTERISTICS OF INTERFERENCE DISPLACEMENT METERS

LENKOVA, G. A., Novosibirsk

[Abstract] It is known that dispersion of laser radiation leads to a reduction of contrast of the interference fringe and a decrease of the precision of read-out of the order of interference. In order to reduce the dispersion of the interferometer input, a collimator which is a "reverse" telescope is ordinarily installed after the laser. In the present paper, the author analyzes the conditions for obtaining minimum dispersion of radiation after the collimator, and an analytical connection between the amount of dispersion and the amplitude drop of the interference signal is established. Agreement of the parameters of the resonator and collimator is considered, and the results are presented in a table of calculations of the radiation parameters b, ω, θ for an illumination typical for IPL interferometers. The data in the table were composed for a type sphere-plane resonator ($f = 160$ mm, $R = 500$ mm) installed at a distance of 110 mm from the collimator. It is shown that for each separation of the colli-mator from the laser, which in the general case is determined by the design of the device, a confocal parameter exists, during which the radiation disper-sion has a maximum value. A change of b_o to the side of an increase or decrease always leads to a decrease of the dispersion of the laser beam. The effect of radiation dispersion on the amplitude of the variable interference signal is studied, and an analytical connection, suitable for practical purposes, is established between a decrease of this amplitude and the angle of dispersion of the radiation after the collimator of the laser interferometer. The results of the work can be useful for developers of the optical trains of laser inter-ferometers of various designs. Figures 3; tables 1; references: 5 Russian.
[319-6415]

OPTICAL DISCRIMINATOR OF DOPPLER FREQUENCY SHIFT

BELOUSOV, P. Ya., VOLKOV, Ye. G., DUBNISHCHEV, Yu. N. and PAL'CHIKOVA, I. G.,
Novosibirsk

[Abstract] It is shown in the literature that use of an optical discriminator
of a Doppler frequency shift makes it possible to obtain an analogous signal,
proportional to the motion speed of a scattering medium by means of direct
treatment of an optical signal in a real time scale. Devices were considered
with a discriminator made in the form of a Fabry-Pero interferometer with plane
or spherical mirrors. It has been shown that meters of this type can operate
with joining of the resonance frequency of the transmission channel of the
discriminator to the frequency of information of a beam scattered by a moving
object, or to the frequency of the reference beam. A significant shortcoming
of the systems described is the fact that for read-out of the operating point
at the linear section of the discrimination characteristic, it is necessary for
the experimenter to have a priori information concerning the magnitude of the
average speed of the scattering medium. In the present brief communication,
the authors consider the possibility of operating an optical discriminator of
doppler frequency shift with automatic joining of the operating point to the
linear section of the discrimination characteristic. A block diagram is shown
of one of the possible realizations of such a device, and its method of opera-
tion is explained. A photograph is presented of a signal from the output of
an optical discriminator, and for comparison, a signal from the output of a
tachometer generator. The photographs made from the screen of a two-beam
osc'.lograph illustrate the possibility of obtaining information concerning
deviation of the doppler frequency shift in a real time scale. The technical
parameters of the experimental device are analogous to the parameters of the
device described in two 1977 papers of which Belousov was the principal author.
Figures 2; references 2: 1 Russian, 1 Western.
[319-6415]

SPECIAL RECORDING FEATURES OF INTERFEROGRAMS OF NONLINEAR REFRACTIVE INDEX

AL'TSHULER, G. B. and KHRAMOV, V. Yu.

[Abstract] As shown in a 1977 work by Al'tshuler, one of the most reliable and
sensitive methods of measuring nonlinearity of the refractive index is the

interferometric method with visualization of the interference field. The
principal problem which originates during recording of interferograms is connec-
ted with the nonstationarity of the interference field which is caused by the
fact that with a change of intensity of the light during a pulse, a corresponding
change takes place of the refractive index of the medium, which leads to a
shift of the position of the interference bands in the recording plane of the
interferogram. The duration of the light pulses amounts to 10^{-8}-10^{-12} second.
Consequently, derivation of interferograms with time resolution, for example,
with the aid of an electronic-optical chamber considerably complicates the
technique of the experiment. In addition the limiting time resolution attained
at present in devices for recording optical signals amounts to 10^{-12} second which
makes impossible accomplishment of time resolution of interferograms during
investigation of light pulses shorter than 10^{-12} second. In the present,work,
it is shown that with a known mechanism for establishment of nonlinearity of
the refractive index of a medium, determination of the component of the ensor
of nonlinear receptibility X^{1111} is sufficient to record the interferograms in-
tegrated in time. Use of the results obtained for processing of interferograms
patterns during recording of an interference field on photographic film or a
vidicon is not limited by the non'inear sensitivity of the visualizer, onto the
transfer function of which only one level is imposed--a monotonic change with
an increase of the energy density of the light flux. The analysis conducted
makes it possible significantly to simplify the procedure for measuring the non-
linearity of the refractive index because of the use of a recording device with-
out time resolution. The results obtained in the present work can also be used
with interference recording of nonstationary changes of the phase objectives
of an arbitrary nature. This paper was recommended by the Department (Kafedra)
of Physics, Leningrad Institute of Precision Mechanics and Optics. Figures 2;
references 2: 1 Russian, 1 Western.
[348-6415]

PHOTOELECTRIC RADIATION PYROMETER

VOLCHEK, A. D. and DZHAYZAKOV, V. M., Institute of Nuclear Physics,
KaSSR Academy of Sciences, Alma Ata

[Abstract] A photoelectric radiation pyrometer is described in which the
interval of measurable temperature amounts to 1300 ÷ 3300 K with a precision
of measurement not worse than 20 K. With an unknown coefficient of blackness
of the radiator, measurements were made with an error of 50 K. The anomalous
photoconducting transducer which serves as the temperature transducer is placed
in a cryostat. It consists of two films of As_2Se_3 and HgSe deposited in series
on a plastic substrate of $1 \times 3 \times 8$ mm^3. Measurement of the temperature can be
made by quasi-dark conduction and time relaxation of the transducer. Both

methods of measurement make it possible to calculate the calibration curve of
the temperature transducer. Figures 2; references: 4 Russian.
[320-6415]

DIGITAL BIAS VOLTAGE REGULATOR FOR SEMICONDUCTOR DETECTORS

GALDYSHEV, D. A., KASATOV, V. L. and LI, B. N., Institute of Nuclear Physics,
UzSSR Academy of Sciences, Tashkent

[Abstract] A multipurpose digital voltage regulator is described, which can be
used with any source of voltage. Regulation is accomplished by steps < 10 V.
The maximum regulated voltage is 2.5 kV with a load current of 1 microampere.
The times for establishment of the final value and the magnitude of the stages
are measured so that the rate of change of increase or fall-off proves to be
equal to ~50v/min. In order to regulate the voltage, a divider is used of
fixed resistors, commutated by RES-0 contact relays. The contact relay was first
investigated for efficiency during switching of 2 kV voltage with a 10 micro-
ampere current. After $5 \cdot 10^4$ switchings there was no noticeable worsening of
the quality of the contact. The circuit of the digital bias regulator is pre-
sented and its method of operation is explained. Figures 1; references 5:
4 Russian, 1 Western.
[320-6415]

DIGITAL OSCILLOGRAPHY

BERKUTOV, A. M., candidate of technical sciences

[Abstract] The design and the capabilities of digital oscillographs are
discussed, such an instrument most generally consisting of an input device,
an analog-to-digital converter, a memory with image forming devices, a processor,
and internal as well as external interfacing synchronization. These instru-
ments operate in two modes: first pretrigger recording, at a given usually
high frequency, of codes into which a signal has been converted, then processing
and display at some usually lower frequency. It is possible to provide adaptive
operation by automatically matching the sensitivity, the discretization fre-
quency, the memory volume and the data capacity to the parameters of the input
signal through a feedback loop with an analyzer of instantaneous values. It is
furthermore possible to construct the imager in the form of matrix-type indicator

panels. The main advantage of a digital oscillograph is its high precision; a basic disadvantage is the narrow bandwidth. Both digital and analog signals can be generated in such an instrument. Figures 8; references 35: 30 Russian, 5 Western.
[371-2415]

IRIS-12 MEASURER-RECORDER OF PULSE SIGNALS

PISARSKIY, A. V., SMIRNOV, A. N. and KOZLOV, A. V.

[Abstract] An instrument is described which is intended for measurement under laboratory conditions of the amplitude or area of single or seldom recurring video pulses of negative polarity, incoming from various converters of non-electrical magnitudes. The instrument has two measurement channels, and a divider of the measurement results. Magnetic recording of the results is possible. The special features of the instrument are: 1) Gating of the input pulses of the signals in both channels which results in an improvement of the signal-to-noise ratios; and 2) Gating of the synchronization channel for improvement of its noise immunity. The technical characteristics and a photograph of the instrument are presented. Figures 1.
[320-6415]

DISCRIMINATION CHARACTERISTIC OF MICROWAVE RESONATOR-DETECTOR SYSTEM

METSNER, Ye. P. and MAL'TSEVA, T. G.

[Abstract] The two main components of an automatic frequency control for microwave measuring instruments are the resonator and the detector. Here the discrimination characteristics of the resonator-detector system are analyzed, the resonator being either a transmission type or a reflection type (with a circulator). The input signal to the resonator comes from a frequency modulator and the output signal from the square-law microwave detector goes through an amplifier to a phase detector. Optimum tuning of the phase detector is effected by introduction of a compensating phase shift near resonance. Expressions derived for the discrimination characteristic simplify for small modulation index, in which case computer calculations are accurate within 0.5-1%. Figures 4; references 4: 3 Russian, 1 Western.
[360-2415]

REFERENCE STANDARDS OF HIGH ELECTRICAL RESISTANCE: CERTIFICATION EQUIPMENT
AND METHODS

KLIBANOV, L. I., candidate of technical sciences, SHIGORIN, V. P., candidate of technical sciences, PAVLENKO, Ye. S., engineer, TSISUN, S. P., engineer, CHERNOV, A. M., engineer, SHEVCHUK, G. I., engineer, and YUDKOVICH, I. Sh., engineer

[Abstract] In a joint effort, the "Mikroprovod" (Microwire) Scientific-Industrial Association in Kishinev and the All-Union Scientific Research Institute of Metrology imeni D. I. Mendeleyev in Leningrad have built, certified and practically implemented a system of primary and secondary reference standards of high d.c. electrical resistance together with the necessary measuring equipment. The etalons cover the 10^{-3}-10^{12} Ω range with a standard deviation of 0.00001%. The equipment consisting of MKSh and U400 comparator test stands measures 10^{-3}-10^5 Ω with a 10^{-7}-$5 \cdot 10^{-7}$ error, 10^6-10^{10} Ω with a 10^{-7}-10^{-6} error, and 10^{11}-10^{12} Ω with a $5 \cdot 10^{-6}$-10^{-5} error. Thermostatization maintains the temperature inside the 80 l large test chamber within 0.02°C. The etalons have a long-term stability, changing by less than 0.001% over a period of three years. A new calibration and transfer procedure has been developed for these R4063-67 and R4080-83 microwire resistance etalons, on the basis of a thorough error and reliability analysis, with the use of various special-purpose 30-2000 V d.c. bridges with proper grounding and insulation. These new reference standards are compared with existing foreign (US, Canadian, Swiss) ones. Figures 8; tables 5; references: 10 Russian.
[371-2415]

AUTOMATIZED INSTALLATION FOR MEASUREMENT OF GALVANOMAGNETIC CHARACTERISTIC OF
LOW RESISTANCE SEMICONDUCTORS WITH STRONG ELECTRICAL FIELDS

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[Abstract] A block diagram is presented and a description given of an installation for automatic registration of the field relationships of current, mobility and concentration of carriers in semiconductor specimens with a continuous change of the electrical field intensity in a range of temperatures from 4.2-300 K. So far as the author knows, an installation of similar type is not found in the literature. The automatic measuring is achieved by the use in the circuit of a stroboscopic oscillograph and an analog computer. With the object of demonstrating the installation, measurements were made on specimens of Te at 4.2 K and

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MODULATOR-SPLITTER BASED ON KRS-5

MASTIKHIN, V. M. and SHELOPUT, D. V., Novosibirsk

[Abstract] The use of lasers for measurement of velocity is placed in an independent area--laser doppler location. At the base of the method is the determination of a doppler frequency shift in light diffused by extrinsic particles in the flux. The introduction of a doppler shift into the diffused light beam is accomplished by a method of optical heterodyning of the reference and diffused beams or by two diffused beams. It is possible to accomplish splitting of the beams and a frequency shift with the aid of acoustooptical ~lements. The universality of acoustooptical devices makes it possible to combine in one cell splitting and frequency shift of one of the beams. Also, use of a two-coordinate cell makes it possible simultaneously to measure the magnitude and direction of two of the orthogonal components of the velocity vector. The angle of splitting and the magnitude of the frequency shift are determined by the ultrasonic velocity in the material of the light-acoustic line. The present work discusses light-acoustic lines used in an acoustooptical modulator-splitter which are obtained from bromide-thallium iodide (KRS-5) single crystals. Such crystals have a high acoustooptical quality, moderate absorption and low ultrasonic velocity. They are series produced by Soviet industry. Until recently, the quality of the crystals in the visible region of the spectrum did not satisfy requirements imposed on a modulator-splitter for a laser doppler velocimeter because of internal voltages, the result of the inhomogeneity of distribution of the composition. However, it has been possible to remove the optical inhomogeneities caused by these voltages by additional thermoprocessing. During preparation of the light-acoustic line, it is necessary to pay particular attention to checking the homogeneity of the crystal in polarized light. The principal technical characteristics of the modulator-splitter are presented. Figures 3; references 2: 1 Russian, 1 Western.
[319-6415]

MULTICHANNEL ANALYZER OF SIMULTANEOUS PULSES

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imeni Ordzhonikidze

[Abstract] Storage of pulse areas during amplitude analysis of single signals,
entering simultaneously from a large number of transducers, makes it possible
to achieve high precision and speed of response with a considerable simplification
of equipment. The method is employed in cases where the form of the input signals
is identical, which occurs for example in experiments concerned with the process-
ing of scattered laser radiation. In the present paper the authors describe a
multichannel device for analysis of the pulse-height distribution of a combination
of simultaneously appearing single pulses. The following circuit solutions are
used in the analyzer: 1) Transducers with a large input resistance are used as
transducers of the input signals; 2) Current selectors based on bipolar transistors
are used as strobing integrators; and 3) Charge transfer is used for a successive
survey of the energy storage capacitors. The circuit and time diagrams are
presented and explained. The analyzer has the following characteristics: number
of single-type circuits, 8; range of measurable current signals, 10 microampere $\div$
$\div$ 10 milliampere; adjustable period of sweep of amplitude distribution, 1 $\div$ 5
microsecond; duration of input signals, 20 $\div$ 50 nanosecond; dynamic range,
allowing for spread of transfer constant with respect to channels, $\geqslant$ 40 dB;
power input, 2W; magnitude of reserve capacitors, 51 picofarad. FEU-79 photo-
multipliers were used as transducers of the input current. Triggering of the
analyzer was performed from a high-speed coaxial photoelement structurally con-
nected with a laser. The analyzer is simple, reliable and convenient to operate.
It has been used for a long time in a complex of diagnostic equipment for
measuring the electron temperature of plasma by the Thomson scattering. Figures 2;
references 2: 1 Russian, 1 Western in translation.
[320-6415]

THERMOMETRIC PROPERTIES OF GALLIUM ARSENIDE LIGHT EMITTING DIODES

VAYNRUB, A. M., TEDER, Kh. L. and LIPPMAA, E. T., Institute of Cybernetics,
ESSR Academy of Sciences, Tallinn

[Abstract] The authors describe the use of AL103B GaAs light emitting diodes
produced by industry as temperature-sensitive elements in the 4 $\div$ 300 K range

with a precision to 0,01 K. GaAs light emitting diodes of six types were tested. The dependence of voltage on four AL103B light emitting diodes on a temperature with forward current of 50 microampere is presented. At room temperature the thermal sensitivity of the diode amounts to 2.5 mV/K and decreases to 1.1 mV/K at T = 80 K. In the range T < 50 K, the characteristics of different specimens diverge. The sensitivity at this section increases with a reduction of the temperature and reaches $100 \div 400$ mV/K at T = 4.2 K, which makes it possible to record a change of temperature of 10^{-4} K. The small dimensions of the AL103B diodes (1.5×2.5 mm^2) causes low inertia and makes them suitable transducers for thermometry. Figures 1; references: 5 Russian.
[320-6415]

EVALUATING LUMINANCE OF OBJECT IN INFRARED BAND WITH AID OF LIGHT EMITTING DIODE

KRUUSING, A. G., RUMMA, K. Ya. and BRYUKHANOV, A. S., Institute of Thermophysics and Electrophysics, ESSR Academy of Sciences, Tallinn

[Abstract] In a number of cases, in particular during an investigation of the dynamics of recombination radiation from power thyristors, it is necessary to record a rapidly changing light signal in the near infrared region. As shown in a 1978 paper of which Kruusing was the principal author, in these cases it is sound practice to use the UMI-93 pulse electron-optical converter (EOC) with an Ag-O-Cs photocathode. The standard signal for evaluation of the luminance of an object must be selected in such a way that it is analogous with the signal being recorded. Here, the AL108A light-emitting diode is used which radiates pulses of infrared light of rectangular form with a duration of 130 microsecond. The optical train of an attachment to the EOC is presented. The principal circuit is shown of a generator of current pulses, developed in order to obtain calibrated light pulses for the light-emitting diode. In order to calibrate the attachment to the EOC, the dependence of the intensity of radiation of the AL108A on the current was investigated and a curve of this is shown. With currents > 10 mA the dependence is linear and with smaller currents it is square. Figures 4; references 3: 2 Russian, 1 Western.
[320-6415]

OPTIMAL PROCESSING OF OPTICAL SIGNAL FROM LASER-TYPE DOPPLER VELOCIMETER

MANDROSOV, V. I. and FOMENKO, S. D.

[Abstract] A laser-type Doppler velocimeter is considered and an algorithm
is constructed for optimal processing of its optical output signal, taking
into account its statistical characteristics. Accordingly, it is assumed that
the source emits a quasi-monochromatic wave which a particle, a scattering
center, scatters in accordance with the Huygens-Fresnel principle. The field
in the receiver aperture is a plane wave, its amplitude being a random process
and its modulation caused by Doppler shifts of reflected waves also being a
random process. It is assumed, furthermore, that the optical signal appears
at the receiver aperture together with a white Gaussian noise of a given spec-
tral density. The optimum receiver must form a functional of the likelihood
ratio which in the space of two radial coordinates and two time coordinates
is a quadruple integral. It is demonstrated that the algorithm of processing
by such a receiver, namely formation of the image of the scattering center in the
focal plane of the receiver lens, is physically realizable by linear optical
filtration with the aid of a Fabry-Perot interferometer or by optical photo-
mixing with the use of a reference beam. In the first method the optimum re-
ceiver must track the image of the scattering center. In the second method
mixing is followed by linear filtration of the electric signal and detection
of the envelope. Figures 4; references: 4 Russian.
[365-2415]

INSTALLATION FOR INVESTIGATING LOW-FREQUENCY NOISE OF AUTOELECTRIC EMISSIONS
OF CATHODES

BAKHTIZIN, R. Z. and GOTS, S. S., Bashkir State University, Ufa

[Abstract] An installation is described which makes it possible operationally
to measure the spectral density of the power of the noise currents of auto-
electric emission in the frequency range of 1 Hz $\div$ 200 KHz and to investigate
the steadiness of the noise. The high current sensitivity is obtained because
of the use of a special current amplifier with an input impedance up to 100 Mohm
and an input capacitance < 0.05 picofarad. The principal circuit of the current
amplifier is shown and an explanation is given of its method of operation.
Figures 1; references 7: 6 Russian, 1 Western.
[320-6415]

DIGITAL SYSTEM OF PRECISION PLATFORM CONTROL

GOVORUN, V. N., IN'SHAKOV, V. I. and USTINOV, Ye. A., Institute of High Energy
Physics, Serpukhov

[Abstract] The authors describe an autonomous digital system for control of
the position of a precision platform which is employed in a measuring device
and can be used, for example, in position devices of machine tools. The system
assures precision of position of ~ 2 micrometer and a maximum linear velocity
of ~ 100 mm/second. A functional diagram of the digital system of control is
presented and explained. The circuit of the code-to-pulse width converter is
shown as part of basic circuit of the overall system. The family of static
characteristics of this converter is presented along with various values of the
frequency of the timing oscillator. The velocity-to-code converter used in the
device is described. A calculation is examined of the transfer conversion ratio
of code-to-pulse width and velocity-to-code converters as a function of the
static moment of the load and the required electromechanical rigidity of the
device. By taking stock of the rapid development of digital microelectronics,
in particular, the creation and output by Soviet industry of integrated circuits
of a medium and large degree of integration, as well as of microprocessors,
the preemittance of digital systems of control becomes evident, excluding
analogous signals and circuits, which considerably improves the static and
dynamic parameters of servodrives. The digital system of control of a servo-
drive fulfilled by a motor with a printed armature was tested on a scanning-
measuring device, and it can also be used in the position systems of metal-
working machine tools. Figures 3; references: 3 Russian.
[320-6415]

MATERIALS

LONG-TIME DURABILITY AND DEFORMABILITY OF POLYMER MATERIAL USED IN TRANSFORMER BUILDING

BORODAY, I. A., candidate of technical sciences and POPOV, A. V., engineer

[Abstract] The paper is concerned with the practical problem of forecasting long-time durability and deformability of specific polymer materials but not with conducting multi-year tests. The general procedures and specific measures for evaluating the rheological characteristics of polymer materials are outlined. On the basis of accepted concepts, an extensive set of curves in the region of necessary durability was constructed. Using the graphs obtain, acceptable levels of voltage as a function of durability were found and used for practical cal-culations. The All-Union Institute of Transformer Building carried out work by these procedures on the evaluation of the rheological characteristics of Mark DSP-A-OET laminated-wood plastic materials with respect to its use in the supporting insulation elements of power transformer construction. Graphs are presented of the long-time durability of various insulation materials; and the creeping of DSP-A-OET material. The results of the investigations made it possible to obtain acceptable voltage levels and magnitudes of deformation of a plastic. Tests of experimental specimens of Types TDTN-40000/110 and TM-2500/35 transformers constructed with the new laminated-wood plastic made it possible to recommend the plastic for production. Figures 4; references: 6 Russian.
[359-6415]

MICROELECTRONICS

STABILIZATION OF LOGICAL LEVELS AND SWITCHING THRESHOLDS OF SMALL-SIGNAL
CIRCUITS OF EMITTER-COUPLED LOGIC

IVANOV, Yu. P. and SHAGURIN, I. I.

[Abstract] The paper determines the requirements for stability of the sources
of currents and reference voltages for the elements of a small emitter-coupled
logic. A description and comparative analysis is given for circuits which
assure the necessary stability of the logical levels and switching thresholds
of these elements with supply voltages $E \le$ (4-5) V. It is concluded that:
1) Construction on the basis of small-signal elements of emitter-coupled logic
of superfast large integrated circuits, of working capacities with reduced
supply voltages $E =$ (2-3) V over a rather wide temperature range ($\Delta t° = \pm 50°$ C)
is possible with stabilization of logic levels and switching thresholds with the
aid of current sources and stabilizers which assure instability of the current
$\varepsilon_{eqv} < 10\%$. 2) The required value ε_{eqv} is attained with use of method of current
stabilization described in the paper. An analysis of different versions of the
stabilizer circuits shows that these circuits assure $\varepsilon_{eqv} \le 10\%$ with $E =$ (2-3) V
and $\varepsilon_E = \pm 5\%$ in the range (-30°-85° C) and consequently they can be used in the
microcircuits of small emitter-coupled logic. 3) The analytical expressions
presented make it possible to calculate the basic parameters of the current
stabilizers for the elements of the small emitter-coupled logic. The recommenda-
tions made with respect to one or another of the stabilizer circuits considered
as a function of the specified values of the supply voltage E and the number of
current sources n connected to the stabilizer makes it possible for developers
of microcircuits to make a valid choice of a stabilizer circuit for each
concrete case. Figures 5; references 11: 8 Russian, 3 Western.
[339-6415]

ENERGY AND TIME CHARACTERISTICS OF PROM-TYPE CONTROLLED TRANSPARENCIES BASED ON $Bi_{12}SiO_{20}$

TRUBETSKOY, A. V.

[Abstract] The principal characteristics of optically-controlled transparencies (OCT) of programmable read-only memory (PROM) type based on $Bi_{12}SiO_{20}$ are studied in the literature. However, no investigations have been made of the speed of response of the OCT of PROM, which is closely connected with the special features of pulse recording in such devices. In the present paper, on the basis of measurements of the energy and time characteristics of pulse optical recording, results are obtained which give an indication of the kinetics of production of optical recording in OCT on the basis of $Bi_{12}SiO_{20}$ and the distinctive features of recording short light pulses. Consideration is given to the residual photo-conductivity in $Bi_{12}SiO_{20}$ crystals after exposure to a pulse of exciting light which limits the number of "record-erase" cycles in the OCT for a unit of time. The following concepts are considered: 1) Process of forming optical recording; 2) Recording of short light pulses; and 3) Residual photoconductivity. It is concluded that the proposed method of experimental investigation of the energy-time characteristics of OCT PROM makes it possible to study the special features of pulse optical recording which determine the speed of response of the OCT. For an OCT based on $Bi_{12}SiO_{20}$, it is established: 1) The energy of light required for recording increases during times of forming a recording less than 20-30 microsecond. The minimum time of forming a recording, obtained in the experiment, amounted to 6-10 microsecond. 2) In a regime of recording short light pulses and read-out with a delay, an increase is observed of the photosensitivity of the OCT, and the energy of recording does not depend on the duration of the light pulse. 3) The maximum duration of the frame of recording-read-out of data in OCT and the minimum interval of the time delay between frames are limited by virtue of the residual photoconductivity in a $Bi_{12}SiO_{20}$ crystal. In the specimen investigated, long-duration of the residual photoconductivity is observed with a decay time of ~ 270 microsecond. The special features of pulse optical recording of data in OCT are determined a great deal by the processes of photoconductivity of the $Bi_{12}SiO_{20}$ crystal. In particular, a large role is

played by the capture of current carriers by traps, which leads to long-duration residual photoconductivity after cut-off of the recording light. In order to increase the frequency of interchange of the frames in OCT it is advisable to use a crystal with a low concentration of traps. The authors thanks P. Ye. Tverdokhleb for attention to the work, as well as M. P. Petrov and A. V. Khomenko for granting specimens of OCT PROM for investigation. Figures 5; references 6: 2 Russian, 4 Western.
[319-6415]

AUTOMATIC SYNTHESIS OF CATADIOPTIC LENS

IVANOV, A. V.

[Abstract] An algorithm of automatic planning of catadioptic astro-objectives is described. The algorithm makes it possible, in addition to synthesis of the initial designs, successfully to carry out its further optimization by compensation for aberrations of higher order—aberrations of the third order. As an example of the operation of the algorithm, a calculation of a catadioptic lens is conducted. A drawing of the lens is presented. The paper was recommended by the Department (Kafedra) of the Theory of Optical Devices, Leningrad Institute of Precision Mechanics and Optics. Figures 1; references: 2 Russian.
[348-6415]

SCANNING ELECTRON MICROSCOPE AS TELEVISION SYSTEM

GOLUBEV, V. P.

[Abstract] Little attention has been given in the past to the concept of a scanning electron microscope (SEM) as a television system. If in a SEM the term "aperture" is used as in television, then in this case it is necessary to understand, not merely the form and dimensions of an electron probe which scans the surface of an object, but rather the dimensions and form of distribution of the intensity of secondary emission generated as the result of interaction of the electron probe with the substance of an object. With one and the same electron probe, the aperture of the SEM can have various dimensions as a function of the form of the secondary emission detected. The minimum aperture

the SEM can have is during operation in a regime of detection of elastically
reflected electrons which have lost the least quantity of energy during inter-
action with an object. In this case the aperture of the SEM practically coin-
cides with the aperture of an electron probe. The maximum aperture a SEM can
have is during detection of absorbed electrons, because absorption of primary
electrons takes place in all the volume of the interaction region. In order to
determine the special features of a SEM, the author conducts a comparative
analysis of the characteristics of an ordinary television system and the charac-
teristics of a SEM operating in a regime of detection of secondary-electron
emission. The characteristics of SEM are investigated with the aid of a model
which assumes that the secondary electron emission of an object proceeds only
from a surface layer and does not allow for the effect of all the area of inter-
action of the probe with the material of an object. In the present work, an
effort is made to eliminate this defect. It is shown that the frequency-contrast
characteristic of the SEM with respect to its shape resembles the frequency
characteristic of a video amplifier with powerful high-frequency correction.
The frequency-phase characteristic is substantially nonlinear and as a result
of it the SEM operates with a forecast of large images with a delay of the
fine details. Distribution of the intensity of the secondary-electron emission
of the object during its interaction with the electron probe of the SEM is also
calculated. The characteristics described of a SEM as a television system are
a consequence of the special features of the conversion of a 3-dimensional
process of interaction of an electronic probe with the material of an object
in a 1-dimensional video signal. A reflection of the special features indicated
is the fact that we see an image of the topography of the surface of an object
as if it were "illuminated" from within. In the given case, the region of
interaction of the primary electrons with the material of an object serves as
the illumination. Figures 6; references 6: 4 Russian, 2 Western.
[328-6415]

SHIFT OF SIGNAL PHASE IN RECEIVER WITH AVALANCHE PHOTODIODE

MERKISHIN, G. V.

[Abstract] Avalanche photodiodes are used in optical receivers, also simultane-
ously as radiation detectors and mixers at the modulation frequency, in systems
where the phase of the signal is an information carrier. Here the shift of the
signal phase caused by inertia of the charge-carrier multiplication process is
calculated from the expression for the output current and an expansion of the
multiplication factor M as a function of time into a Fourier series of hetero-
dyne harmonics, assuming that approximately $1/M = f(V)$ (V--supply voltage) and
that the degree of impact ionization is the same for electrons and holes. Also
curves are shown depicting the dependence of the phase shift of the

difference-frequency harmonic on the supply voltage and on the amplitude of
the heterodyne signal. Figures 2; references 2: 1 Russian, 1 Western.
[365-2415]

LINEAR OPTOELECTRONIC DECOUPLING DEVICES

MAMEDOV, A. K. O.

[Abstract] Optrons are suitable devices for use in transmission of analog
signals over galvanically decoupled circuits, inasmuch as they open "stray"
grounding loops between stages operating under different electrical conditions.
Here the main performance parameter of a differential optron is analyzed, namely
the linearity of its transfer characteristic. For calculation of the nonlinearity
factor, a measure of the relative departure from linearity, the transfer function
is put in the approximate form of a monomial with the linearity index as the
power exponent. The output voltage is then calculated by way of a binomial
series expansion and retention of only first-order terms. The results indicate
that the linearity of such a device can be improved by narrowing the current
swing, with a penalty in the signal-to-noise ratio, or by matching of both
optrons in the differential stage with respect to linearity. Figures 2;
references: 2 Russian.
[360-2415]

OSCILLATORS, MODULATORS, GENERATORS

PUSH-PULL QUARTZ OSCILLATORS WITH FIELD-EFFECT TRANSISTORS

SOKOLOV, O. T.

[Abstract] Two push-pull quartz oscillators with field-effect transistors
are described, capacitive Hartley oscillators with common drains or common
gates respectively. A performance analysis based on their equivalent circuit
diagrams and an approximately parabolic current-voltage characteristic of
field-effect transistors indicates that the frequency stability here is higher
during variations of the transfer capacitances and much lower during variations
of the barrier capacitances than, respectively, the frequency stability of
single-stage oscillators. These theoretical conclusions have been confirmed
by experiments. A quadrupling of the supply voltage produced a less than
$3 \cdot 10^{-6}\%$ relative change in the output frequency and an only 10% change in
the amplitude of the output signal. Figures 5; references 7: 5 Russian,
1 Polish, 1 German.
[360-2415]

ASYMMETRY OF CHARACTERISTICS OF DIODE-TYPE MICROWAVE OSCILLATOR WITH EXTERNAL
SYNCHRONIZATION

MASLOV, A. V.

[Abstract] The frequency characteristics of a diode-type microwave oscillator
with external synchronization are analyzed on the basis of the equivalent
circuit consisting of an LC tank and an active element. A solution, by simula-
tion on a digital computer, of the system of nonlinear equations describing the

steady state of a synchronized oscillator indicates that the asymmetry of its amplitude-frequency, power-frequency, and phase-frequency characteristics with respect to the center frequency could be caused by an asymmetric frequency dependence of the load conductance across the active element. Such an oscillator can, therefore, be used for compensating the asymmetry caused by a nonlinear reactance of the active element or by other causes such as a time delay in the feedback circuit. Figures 4; references 7: 6 Russian, 1 Western.
[360-2415]

GENERATOR OF HEAVY-CURRENT HIGH-VOLTAGE PULSES WITH STABILIZATION OF PEAK

SAVKIN, V. Ya., Institute of Nuclear Physics, Siberian Department,
USSR Academy of Sciences, Novosibirsk

[Abstract] The circuit is presented of a generator of square pulses with stabilization of the peak by ONS and SN2 semiconductor devices. Use of these semiconductor devices made it possible, with simple circuit solutions to realize stabilization of pulses. The parameters of the generator are: load voltage, to 30 kV; current to 75 A; instability of peak, < 0.5%; duration of plane part of pulse, 200 microsecond. Use of an artificial line as a modulator makes it possible to form square pulses, completely using the energy stored in the capacitors of the line to limit the maximum developed current during breakdowns in the load. Figures 3; references: 1 Russian.
[320-6415]

PHOTOELECTRIC PHENOMENA AND DEVICES,
ELECTROLUMINESCENCE, ION DEVICES

CALCULATING FREQUENCY CHARACTERISTICS OF PHOTOELECTRON MULTIPLIER

GOVORUN, D. N., KONDILENKO, I. I. and KOROTKOV, P. A.

[Abstract] The frequency characteristics of a photoelectron multiplier are
calculated on the basis of the statistical model, where the secondary-electron
gain and the electron transit time are random quantities. The calculation
involves a Fourier transformation of the monoelectron pulse and the pulse-
response characteristic. As a result, rather simple expressions are obtained
for amplitude-frequency characteristic and the phase-frequency characteristic
of such a device with directly measurable inertia parameters and load character-
istics. These expressions are useful for engineering calculations and design
of wideband noise generators or optical recievers. References 19: 18 Russian,
1 Western.
[336-2415]

CIRCUIT ENGINEERING AND STRUCTURAL SPECIAL FEATURES OF MULTIELEMENT INTEGRAL
MIS-PHOTODIODE DEVICES

NAYMARK, S. I., Novosibirsk

[Abstract] A general method is presented for evaluating the different struc-
tural organization of multielement photosensitive devices based on metal-
insulation-semiconductor (MIS) photodiode cells. A schematic diagram is shown
and discussed for a cell which represents a MIS-transistor structure with an
insulated source and together with a substrate forms a photodiode. There are
two operating conditions of MIS-photodiode cells: instantaneous action and

storage. A block diagram of a straightedge MIS-photodiode cell is explained.
The signal-to-time ratio in multielement devices is considered. A block diagram
is presented of a channel for a one-dimension fragment of a device made of
photocells connected to the outputs of read-out buses. Representation of read-
out or sampling of information is in terms of linear transformation. Reali-
zation of linear transformation in the process of sampling does not worsen and
in a number of cases improves the signal-to-noise ratio and the limitation on
the volume of information transmitted, although it is clear that requirements
on the dynamic range and on the band of external amplification circuits during
this are substantially increased. The results of an evaluation of the quality
of transformation for the case of element by element sampling and sampling at
the base of cross-correlation functions are presented. The author is grateful
to Ye. S. Nezhevenko, R. D. Baglay, A. N. Kasperovich, B. N. Pankov and
P. Ye. Tverdokhleb for helpful comments made during discussion of the manuscript
of the work. Figures 5; references 12: 5 Russian, 7 Western (5 in translation).
[319-6415]

POWER SYSTEMS (INCLUDING EFFECT OF
VARIOUS ITEMS ON POWER TRANSMISSION)

SPARK GAPS OF SWITCH-DISCONNECTOR MECHANISM FOR SUPER VOLTAGE

BIRYUKOV, S. V., VOLKOVA, O. V. and KORYAVIN, A. R., candidates of technical
sciences

[Abstract] At present in the USSR the system of protecting super voltage
transmission lines from interior overvoltages includes combined spark gaps,
shunting reactors, spark switching of reactors, as well as protective relaying
and automatics. For spark connecting of reactors, it has been necessary to create
a special apparatus, a switch-disconnector mechanism (SDM) intended for auto-
matic inertia-free switching of a shunting reactor in the case of overvoltages,
as well as for normal switchings of the reactor, necessary with respect to
operating conditions. Use of an open spark gap for switching of a reactor makes
it possible substantially to improve the technical-economical indices of the
SDM as compared with a spark gap of the closed type, because of a decrease of
the dimensions of the equipment (its height, number of modules) and simplification
of the automatics. Investigations were conducted which made it possible to
determine the geometrical parameters of the spark gaps for SDM, the discharge
characteristics of which are subjected to the minimum possible effect of the
form and polarity of the affecting voltage. A method is presented for calcula-
tion of an optimum variation for fulfillment of spark gaps. The VO-750 kV spark
gap was successfully subjected to both laboratory and exploitation tests at an
operating substation. At present the VO-750 is found in operation on the 750 kV
electrical transmission line Vinitsa (USSR)—Al'bertirsh (Hungarian People's
Republic). Figures 1.
[359-6415]

OPTIMUM STEPPED TRANSITIONS

VESELKOV, G. P.

[Abstract] As is known, the lengths of the steps of stepped transformers used for wide-band coordination of transmission lines of electromagnetic energy with various wave impedances are equal to $d = \lambda_0/4$ where λ_0 is the wavelength in the transmission line which corresponds to the average frequency of the operating range. Consequently, with a deviation of the frequency from the average, all the steps simultaneously change to be quarter-wave. The impossibility has been shown of increasing the gain of step transitions by means of a negligible change of the length of the step. As an object of investigation, a coaxial variation of a two-step Tchebyshev transformer of wave impedances was selected, during which only the simplest cases were considered when the lengths of the step differ from four wavelengths at the magnitude $\pm\Delta$. Because the problem is of interest not only from the point of view of single-minded change of the electrodynamic characteristics of the transitions, but is also closely connected with determination of the tolerances on the length of the step, this signifies to some extent that the problem be expanded, taking into consideration also the case of a different change of the length of the steps of the transformer. With this goal there is taken again a two-stage Tchebyshev coaxial transformer but with a length of step $d_1 = d + \Delta_1$ and $d_2 = d + \Delta_2$ and the effect of an individual change of Δ_1 and Δ_2 on the properties of the transmission investigated. The author concludes that it is impossible to increase the gain $r = M/|\Gamma|_{max}$ of the step transitions by any change of the length of step. Any deviation of d_m from $\lambda_0/4$ leads only to an increase of reflections at the input of the transformer. Figures 2; references: 1 Russian.
[331-6415]

PRODUCTION TECHNOLOGY

SERDYUK, G. B., candidate of technical sciences

[Abstract] The purpose of integrated diagnosis is to provide most effective
production quality control and service reliability on the basis of comprehensive
information about the technical state of a given product item. Nonequilibrium
states of any physical system are, according to the phenomenological theory of
irreversible thermodynamic processes, caused by a spatially nonuniform distri-
bution of the temperature, of the rate of convective transfer of potential
energy, or of the partial chemical potentials. Any deviation from a standard
distribution is called a defect, its detection being the object of a diagnostic
procedure. Integrated diagnosis follows the detection of defects through non-
destructive inspection and testing, the data thus obtained then being processed
for identification (classification) of the physical or technical state of a
given product item. For the diagnosis of electrical and radioelectronic pro-
ducts, harmonically varying and constant as well as step and pulse signals are
used as test signals. The diagnosis is then based on an evaluation of non-
linearity effects, of transients and their mathematical approximation, or of
fluctuation processes such as noise with equipment of adequate interference
immunity and resolving power. References 55: 40 Russian, 1 Polish,
14 Western (ten in translation).
[371-2415]

OPTIMIZING GUARANTEED QUALITY MARGIN IN SYNTHESIS OF RADIO ENGINEERING SYSTEMS

DUDOV, S. I. and MESHCHANOV, V. P.

[Abstract] The problem of optimizing the guaranteed quality margin, a most
general performance indicator for series manufactured devices or systems, can
be treated as a maximim problem. Here this generally nonlinear problem is
formulated as a search for the local maximin in the space of discrete variables
and reduced to a solution of a sequence of simpler problems by replacement of
the distance of a parameter value from the boundary of the tolerance space with
a set of points and the boundary itself with a polyhedron. After the necessary
and sufficient conditions for a point to be a local maximin have been established,
an algorithm of the solution is constructed which involves successive approxima-
tions and the testing of each for those conditions. This method of optimization
is demonstrated numerically on the synthesis of a typical radio engineering
device, namely a class-2 3-stage directional coupler. The authors thank
A. L. Fel'dshteyn for the helpful suggestions. Tables 1; references: 5 Russian.
[365-2415]

POWERFUL HIGH-VOLTAGE PULSE TRANSFORMER

VDOVIN, S. S., Dnepropetrovsk State University

[Abstract] The creation of reliable insulation for windings and the production
of large-size cores made of thin strips of ferromagnetic materials are difficult
problems to solve during planning of powerful high-voltage pulse transformers
(PT). However, these problems are solved with relative simplicity in a PT,
the schematic construction of which is shown in the present paper. In a PT
which was produced and tested, the constructive parameters made it possible to
increase the voltage of rectangular pulses, with a duration up to 100 microsec
and a power to 100 megawatts, from 22 to 400 kV with a pulse duty factor > 100,
extending the pulse front in various regimes to 5 ÷ 8 microsecond. On the basis
of the construction described, it can be assumed that with some increase of the
thickness of the insulation gaps, it is possible to obtain voltages to 1 MV.
Figures 1; references 4: 3 Russian, 1 Western.
[320-6415]

QUANTUM ELECTRONICS

MEASURING NATURAL FLUCTUATIONS OF EMISSION FREQUENCY OF LASER WITH λ = 3.39 MICROMETER

MAZAN'KO, I. P., MOLCHANOV, M. I., PETRUKHIN, Ye. A., SAVUSHKIN, A. F. and
YAROSHENKO, N. G.

[Abstract] The fluctuations are measured of the frequency differences of a ring
neon-helium laser at λ = 3.39 micrometer. A mixture of $He^3:Ne^{20}:Ne^{22}$ = 6:1:1
was used in the experiment with a total pressure of 0.8 Tor (107 Pascal). The
methods and equipment employed are described. The spectra are shown of the
fluctuations of the frequency difference with various conditions of the output
power of the laser. The magnitude of the signal-to-noise ratio during this was
not less than 3. The error of measurement of the spectrum intensity amounted
to 5-15% as a function of the passband of the analyzer used. The results obtained
agree sufficiently well with a theoretical evaluation found in the literature.
From the uniformity of the spectrum and the form of its dependence on the power
it can be concluded that in the experiment natural fluctuations of the frequency
were actually observed. Figures 2; references 16: 11 Russian, 5 Western.
[328-6415]

DIFFRACTION EFFECTIVENESS DURING MULTIEXPOSED HOLOGRAPHIC RECORDING

SPASOV, G. A., S"YNOV, V. Kh. and S"YNOV, S. Kh., Sofia, Bulgaria

[Abstract] "Multiexposed" is a holographic recording with the superposition of
lattices of various spatial frequencies or recording at different angles to the
general medium. It is used in order to increase the volume of the information

recorded in holographic memory units, for the creation of generalized holographic filters in systems for optical processing of information, and holographic interferometry. Recording at various wave wavelengths is used first of all for creating color holograms. This method assures a higher information capacity of the recording medium because redistribution of the information degree of freedom leads to a considerable excess of the classic limit of resolution for a plane aperture. The deficiency of multiexposed recording is a decrease of the diffraction effectiveness in comparison with the maximum possibility with single-stage recording. The present work shows the exposed dependences of the diffraction effectiveness of nonwhitened holograms on silver-halide emulsion layers during multiexposed recording. Light-sensitive plates of type XII-490 TsLOZOI BAN (expansion unknown) laboratory glaze with a thickness of the emulsion layer of seven micrometers are used. The plate was processed in the FKhP-3 developer-fixer and the experiments were conducted during recording in the oncoming beams of two plane fronts. Experimental and theoretical results agree well. The authors thank the collective of the TsLOZOL BAN for helpful discussions, the materials submitted and the regime of processing during the conduct of the experiments. Figures 5; references 7: 4 Russian, 3 Western (1 in translation). [319-6415]

DYNAMIC CONTROL OF LASER RADIATION PATTERN ASSISTED BY USE OF FABRY-PERO INTERFEROMETER WITH NONUNIFORM TRANSMISSION

KOL'CHENKO, A. P., NIKITENKO, A. G. and TROITSKIY, Yu. V., Novosibirsk

[Abstract] The authors study a method for control of the radiation pattern (RP) of a laser, which can prove to be a good addition to the tethods already existing and be utilized in those cases when it is necessary completely to change the form of the RP by a change of one parameter. The proposed method is based on space amplitude-phase modulation of the laser beam, during which the difference is modulated of the phases and amplitudes of the fields of two (or more) segments of a beam located in one and the same cross section. An important advantage of the method is the fact that the beam is not stepped down and consequently is practically free of the additional losses of laser power introduced by the modulation elements. A plane-parallel Fabry-Pero interferometer with nonuniform transmission is used as a modulating element. The set up of the method and the amplitude and phase characteristics of the interferometer are shown. An experimental investigation of the proposed method was conducted with an installation created on the basis of a He-Ne laser ($\lambda = 0.63$ micrometer). The complete installation is described. The results of the experimental investigations and the calculations qualitatively agree among themselves, and make it possible to show the practical usefulness of a method for control of a laser within comparatively wide limits. The variety of forms of distributions which can be obtained with

almost a $\sqcap$-shaped intensity profile and with a profile which has a gap in the center, which during specified conditions reaches zero. In addition, it is possible to obtain a RP with a relatively small width of the central lobe. For a number of applications (communication, locating, transmission of light energy to far distances) derivation of such beams is of obvious interest. In contrast to standard active optics devices which modulate only the phase of a wave-front beam, in this method the phase and amplitude also change. This makes it possible to enter the region of RP parameters which are unavailable for pure phase modulation. The absence of useless losses of energy of a laser beam is also a significant merit of the method. The proposed method of space amplitude—phase modulation can be used for control of the RP of a laser, operating not only in the fundamental Gaussian mode but also on transverse modes of a higher order. Figures 5; references 8: 7 Russian, 1 Western.
[319-6415]

INVESTIGATING AMPLITUDE CHARACTERISTICS OF LASER AMPLIFIER OF IMAGE BRIGHTNESS BASED ON SOLUTION OF RHODEMINE 6Zh IN AN ETALON

KASTORNOV, A. A., Novosibirsk

[Abstract] During the creation of an amplifier of image brightness, using a laser based on dye, the problem arose of measuring its dynamic range, determined by the level of spontaneous noise of the laser and by the saturation gain in the dye. This measurement is necessary in order to determine the region of linear amplification in the laser, its maximum energy output, and to evaluate the amount of contrast of the image. In addition, knowing the amplitude characteristics of a laser, it is not difficult to optimize (with specified geometrical dimensions of the amplification channel) the amount of the pumping energy of the laser. Measurement of the dynamic range of a laser based on a dye consisting of Rhodemine 6 Zh was conducted on a unit, a block diagram and explanation of which is presented. Use of the method of measurement described made it possible to establish the limit values of the principal parameters of the laser, and these values are presented. Figures 2; references 3: 2 Russian, 1 Western in translation.
[319-6415]

USING THERMOPLASTIC RECORDING MEDIA IN FIRST CIRCUIT OF TWO-CIRCUIT HOLOGRAPHIC DATA LOCATION SYSTEMS

VERKHOVOY, V. P., ZAYCHENKO, O. V. and KOMAROV, V. A., Vinnitsa

[Abstract] In this brief communication, the authors investigate the possibility of using thermoplastic media as a holographic information carrying medium in the holographic memory unit of the first circuit of a data location system. For this purpose a model was developed of a unit for recording binary information in the form of Fourier holograms based on thermoplastic media with a density of recording of 10^6 bit/cm^2. A block diagram is presented of the optical train of the model and its activity is explained. It is concluded that the investigation confirms the possibility of using a thermoplastic medium in the holographic memory units of the first circuit of data location systems. Figures 2; references 5: 3 Russian, 2 Western (1 in translation).
[319-6415]

RECORDING ONE-DIMENSIONAL HOLOGRAM USING MOBILE MEDIUM

TITOV, A. A., Moscow

[Abstract] It is possible to expect a substantial increase of the data exchange rate in memory units when the one-dimensional holograph method is used in them. A 1978 paper by the author considers the problems of recording and reproducing one-dimensional holograms, using a nonmobile medium. Problems, however, of recording one-dimensional holograms on a moving medium are still insufficiently investigated. In particular, analytical expressions for calculation of the bandwidth of a holographic memory unit (HMU) are lacking, which is very important for determining the carrying capacity of a device, not a procedure for calculating the principal parameters of a HMU in a dynamic regime. It is shown that the transfer function of the medium during recording of information is approximately described by an aperiodic element. The reaction of the medium to a pulse of laser radiation with a duration t_r is found as the difference of two abrupt changes of the intensity of laser radiation. From this expression, the size is found of a hologram during recording on a mobile medium, assuming that the operative aperture of a hologram is calculated at the level $U_{t_1} = 2$. The transfer characteristics of other units of the HMU are determined; the modualtor, the matrix of photodetectors, and the controlled transparent, and

expressions are found which make it possible to determine the power of a signal
at a photodetector. Figures 1, references 10: 8 Russian, 2 Western.
[319-6415]

FORMATION OF COMPLEX DIGITAL HOLOGRAMS AND THEIR OPTICAL IMAGE RECONSTRUCTION

SAFRONOV, G. S., TITAR', V. P. and TOMCHUK, Ye. Ya.

[Abstract] The authors consider an algorithm for forming of complex digital
holograms and the images reconstructed by them during illumination of the
holograms by coherent light. Forming of the complex digital holograms was
performed with the aid of a digital computer. The algorithmic language
"Fortran-4" was used during composition of the programs for synthesis of the
holograms, which assured the feasibility of direct operation with complex
variables. The procedure for obtaining digital holograms amounts to the
following: the field of the images is set in the form of a matrix with a
quantity of 128 x 128 complex elements; by program means, the original image
is formed in the field of images in the shape of geometrical figures (circle,
triangle, ring and others); and for images of specific matrices A(m,n) digital
holograms of Fourier or Frenal are found. The possibility is examined of re-
construction of images by complex digital holograms with the aid of optical
means. Figures 4; references: 2 Russian.
[328-6415]

AUTOMATIC DEVICE FOR RECORDING HOLOGRAMS ON THERMOPLASTIC MEDIUM WITH FLEXIBLE
LAVSAN BASE

VERKHOVOY, V. P., ZAYCHENKO, O. V., KOMAROV, V. A. and SHPIGUNOV, S. N.,
Vinnitsa

[Abstract] The wide use of a thermoplastic medium (TM) in holograph methods
for recording information lacks equipment for work with TM. The goal of the
present brief communication is the development of equipment which achieves a
process of recording holograms on TM with a flexible Lavsan [Soviet equivalent
of Dacron] base, as well as an experimental check of the efficiency of the
equipment. In the general case, the process of recording information on TM

involves charging of the TM surface with the aid of a corona discharge, exposure and development by means of heating. In some case additional "milking" of TM is applied after exposure as well as erasure of the recorded information by means of heating a layer up to a temperature somewhat exceeding the development temperature. For this sequence of operations, the device for recording holograms (DRH) includes a control unit (for automatic control of the charge processes, exposure and development of TM), the VB-1M high-voltage unit with an output voltage of 6-10 kV (for obtaining the corona discharge, sensitizing the TM) and the photo-adapter for recording holograms with a diffraction efficiency specified beforehand. A block diagram of the DRH is presented and its units are explained. The experimental work conducted confirmed the efficiency and reliability of the device and showed that the device makes it possible to conduct all the cycle of recording of holograms on a TM. The necessity for development of the device described is brought about by the fact that at present TM is already produced by experimental parties, but the equipment for recording information on TM is still not produced in series. The developed device satisfies requirements imposed on equipment of the specified type and can be recommended for series production. Figures 4; references: 4 Russian.
[319-6415]

RADARS, RADIONAVIGATION AIDS,
DIRECTION FINDING, GYROS

EXCITATION AND SCATTERING OF ELECTROMAGNETIC WAVES IN PRESENCE OF ROTATING
ARBITRARY CROSS SECTION CYLINDER

PETROV, B. M. and SAVEL'YEV, V. V.

[Abstract] The requirements of radar tachometers, the problem of radar identi-
fication of shapes, and the development of methods and measures for nondestruc-
tive checking govern the statement of the problem of dispersion of electromagnetic
waves on a rotating cylinder of arbitrary cross section. Up to the present a
rigorous solution of this problem has been lacking. Known solutions were obtained
in an approximation with low frequencies of rotation. The mathematical diffi-
culties of a rigorous solution of similar problems are connected with the neces-
sity of introducing rotating systems of reference and integration of Maxwell
equations in space with non-Euclidian metrics. In the present paper, on the
basis of Maxwell equations in a covariant form, the problem is solved of exci-
tation of electromagnetic waves in the presence of a rotating ideally conducting
cylinder of an arbitrary cross section. Calculations for a quadric cylinder are
presented which make it possible to judge concerning the level of the spectral
components of the thinned out spectrum which carries information concerning
rotation, and the distribution of them in space, as well as concerning the
electrical dimension of the cylinder with respect to the ratio of the levels of
the spectral components of the reflected field. The numerical algorithm developed
is also used for calculations of a rectangular and circular cut of the cylinders.
Figures 3; references 10: 9 Russian, 1 Western.
[331-6415]

EVALUATING TIME FOR ATTAINMENT OF THRESHOLD IN DISCRETE ACCUMULATORS WITH
'SLIDING WINDOW' ALGORITHM

POBEREZHSKIY, Ye. S. and SOKOLOVSKIY, M. N.

[Abstract] The "sliding window" algorithm makes it possible to realize procedures
close to optimum from the standpoint of the Neumann-Pearson criterion. This
algorithm involves a displacement along a random sequence of units and nulls of
a "window", which opens n positions of the sequence. The "window" stops when
the number of units at open positions reaches the threshold k. In the detectors,
the sequence mentioned is a model of the flow of excesses of some level by the
references of the output voltage of a detector, and in the synchronization—a
model of the flow of penetrations of the limits of the samples or combinations
at a determined interval. The frequency of false alarms in a fixed distance
ring in a radar, the synchronization time and other parameters of synchronization
are determined by the numerical characteristics of the time T of movement of the
"window" to the moment of attainment of the threshold k. However, even though
formulas of the mathematical expectation M[T] for k = n for several pairs of
values of k and n with k ≠ n are found in the literature, in the general case
derivation of expressions for the numerical characteristics are not successful.
However, in the present brief communication the boundaries of M[T] and the dis-
persion D[T] are determined, from which in a number of cases precise formulas
for these characteristics are obtained. The overall results obtained in the
communication facilitate calculations, not only of radar detectors and syn-
chronization devices for communications, but also other radio equipment. Thus,
for example, in devices for protection from errors, operating in a homogeneous
symmetrical discrete channel with erasing and forming of the "malfunction"
signal, when among n samples k erasures appear, the relationships in this
communication make it possible to evaluate the probability characteristics of
the interval between two neighboring "malfunction" signals. Figures 3;
references: 3 Russian.
[339-6415]

DIGITAL METHOD OF FORMING SEQUENCE OF PHASE SHIFTS AT CONSTANT CARRIER
FREQUENCY

GUBERNATOROV, O. I.

[Abstract] The block diagram is presented of a digital frequency synthesizer
(DFS), the principles of operation of which are thoroughly described in a 1973
paper of which Gubernatorov is the principal author. The possibility of
creating a digital synthesizer of phase shifts (DSP) on the basis of the DFS is
theoretically and experimentally confirmed. The results obtained are general-
ized. The DSP can find wide use, not only in radio receiving devices for
tracking and following moving objects, but also as a controlled delay line.
Figures 3; references: 4 Russian.
[339-6415]

PROPERTIES OF AMBIGUITY FUNCTION OF FREQUENCY SEQUENCES BASED ON LINEAR
RECURRENT SEQUENCES

GONTARENKO, V. P., STRUCHEV, V. F. and CHEKUROV, G. I.

[Abstract] Frequency keyed signals using linear recurrent sequences are quite
useful in radar because of the high range and speed resolution, as well as the
relative simplicity of the hardware for their generation and processing. This
paper analyzes the ambiguity function of such signals in the central portion of
the ambiguity plane to derive expressions for the sidelobes and peaks of this
function. An equation is found which determines the region bounded by the
ambiguity peaks closest to the central peak, although the ambiguity function
has multiple peaks in this central region of the ambiguity plane. Expressions
are also derived for the normalized area free of ambiguity peaks with respect
to the product of the intensity of the main peak along the time axis and the
frequency axis, as well as for the initial value of the frequency and number
of pulses of a k-th linear sequence (the k-th component of a composite signal)
and the number of the pulse position in the overall signal with which the k-th
linear sequence begins. Figures 3; references: 4 Russian.
[334-8225]

POST-DETECTOR LOCAL OPTIMUM ALGORITHM OF SIGNAL DETECTION ON BACKGROUND OF
GAUSSIAN AND NARROW-BAND NON-GAUSSIAN NOISE

BARASHKOV, V. M. and LANDO, V. S.

[Abstract] Local optimum algorithms of signal detection in the neighborhood
of the signal value S = 0 are known. The form of the local optimum algorithm
is presented for the case of post-detector signal detection of a signal with a
random initial phase. In the general case, during signal detection on a back-
ground of nonGaussian noise, determination of the nonlinear characteristic $f(x)$
is combined with considerable mathematical difficulties. In the present brief
communication, the nonlinear characteristic $f(x)$ of the algorithm mentioned
above is determined, with detection of a pulsed radar signal with a random
initial phase. An expression is obtained which makes it possible to determine
in a clear form the nonlinear characteristics of a local optimum with the com-
bined effect of Gaussian and narrow-band nonGaussian noise. Figures 1;
references 3: 2 Russian, 1 Western.
[326-6415]

COMPOUND SIGNALS WITH PUSH-BUTTON INDETERMINACY FUNCTION

CHAYKOVSKIY, V. I.

[Abstract] Signals with push-button indeterminacy functions are used in radar
systems for simultaneous estimation of the Doppler frequency shift and the time
delay. Such signals are produced by frequency or phase modulation. Here the
complex phase modulating functions are considered for a pair of coupled signals
with a comblike indeterminacy function each. The indeterminacy function of
the compound signal is also found to be a comblike one. This makes it possible,
without changing the shape of the probing signal, to realize a push-button
response and a comblike response of the radar receiver channel for autocorrela-
tional and cross-correlational signal processing, respectively. References 3:
2 Russian, 1 Western in translation.
[360-2415]

MEASUREMENT OF MICROWAVE FIELD SCATTERED FORWARD BY CYLINDER WITH ARBITRARY
PROFILE

LANDE, B. Sh. and DOBROVOL'SKIY, D. D.

[Abstract] This brief communication is a continuation of published work done
by the authors between 1979 and the present. Cylinders of various profiles can
be used successfully as reflector standards. In spite of its simplicity in
comparison with three-dimensional objects, acquisition of a bistatic radar
effective scattering area (ESA) is a time consuming problem even for cylindrical
surfaces. In the case of forward scattering use of a reflector in the form of
a flexible film with a resonant corrugation which satisfies conditions of small
disturbances, it is possible to simplify the measuring procedure to a considerable
extent. In so doing, in a Kirchhoff approximation, the field scattered forward
by a smooth cylindrical reflector is proportional to the field scattered back-
wards from a flexible metallized film superimposed on this body. The resonance
mechanism of scattering from a sinusoidal corrugation was repeatedly confirmed
by experiments, including waves of the centimeter band. It is important to
obtain a strict proof of the proportionality of the field scattered in a forward
direction from the cylindrical surface, and the field scattered backwards at
the origin of the wavy film with resonance corrugation superimposed on this
surface. The present work proposes such a proof. On the basis of the discussions
in the work, it is concluded that the form of a cylinder surface and the value
of a surface current at an interface with vertical polarization of the irradia-
ting wave effect the proportionality factor of the field of reverse reflection
and the reflection field in a mirror direction. Consequently, strictly speaking,
the effect mentioned of the proportionality of the field in the forward and
reverse directions, it is necessary in practice to use for the purpose of
measurement of bistatic ESA of a curved surface in a field of horizontal
polarization. Figures 1; references 5: 4 Russian, 1 Western.
[331-6415]

EQUATIONS OF STATE FOR EVALUATIONS OF SIGNAL PARAMETERS IN RADAR AND
COMMUNICATIONS

MEL'NIKOV, B. G.

[Abstract] A solution is found for the problem of nonlinear discrimination of a
multidimensional transient random process which assures maximum probability of

reaching an evaluation of the vector of state in a given region, for signals with a random initial phase, adequately applied to radar and communications. Synthesis of a nonlinear filter is discussed and a block diagram of an optimum filter is presented, defined by equations derived in the work, which differs from known filters by the fact that, in accordance with the criterion of optimality taken, the smoothing circuits contains elements, functionally depending not only on the random error of discrimination, but also on the dynamic error resulting from the quality of reproduction of a regular component of the parameter being measured, and furthermore also from the relations between the random and dynamic errors. Complication of the structure of the smoothing circuits, the result of a solution of the problem of synthesis of a linear filter described in the literature, assures a high stability of the discrimination process under conditions of a priori statistical uncertainty. The results obtained include data from known methods of nonlinear filtration of normal Markov processes as a particular case. Figures 3; references 7: 6 Russian, 1 Western in translation.
[326-6415]

DYNAMIC ERRORS OF KALMAN FILTERING OF TRAJECTORY PARAMETERS

VOLLERNER, N. F. and LAVRINCHUK, V. M.

[Abstract] In systems of automatic treatment of detection and ranging information for precise tracking of piloted objects, algorithms of linear discrete filtration are used, particularly algorithms of Kalman linear discrete filtration. In the present paper, the authors consider the dynamic errors of Kalman filters as applied to an evaluation of the trajectory parameters of piloted objects. A comparison of the results of modelling with calculated data shows that the dynamic errors of filtration of the polar coordinates of piloted objects caused by the noncorrespondence of the linear mathematical model to the real nature of a change of coordinates occurs both with uniform rectilinear motion and with maneuvering objects, and at points of the extremum can reach a considerable magnitude. The analytical expressions obtained in the work make it possible to approximate these errors with a degree of precision sufficient for practical calculations, for constant and slowly changing dispersion of measurement errors in all the range of changing parameters. The results obtained can be used for calculation of the total error of filtration in each concrete case. The results obtained can also be used during Kalman linear filtration of other processes with nonlinear connection of the filtered parameters with the coordinates observed. Figures 1; references: 7 Russian.
[326-6415]

PECULIARITIES IN EVALUATING EFFICIENCY OF MOVING-TARGET-INDICATION SYSTEMS WITH NONCOHERENT PULSE STORAGE

FEDININ, V. V.

[Abstract] Probability of correct detection and probability of false alarm are suggested as criteria for evaluating the efficiency of moving-target-indication systems, these criteria yielding better estimates than energy criteria in the case of noncoherent pulse storage. Both probabilities are defined as probabilities of threshold crossing, respectively, in the presence and in the absence of a useful signal. They can be calculated with the aid of either the Heaviside expansion or the inverse Fourier transformation. A numerical evaluation of the detection threshold by computer experiments reveals that the second method is more accurate and can be accelerated by the use of the gamma-function distribution equal to the first term of the Laguerre series. References 7: 5 Russian, 2 Western (in translation).
[336-2415]

SEMICONDUCTORS AND DIELECTRICS,
CRYSTALS IN GENERAL

CURRENT-VOLTAGE CHARACTERISTIC OF SEMICONDUCTOR STRUCTURES WITH DIFFUSED P-N
JUNCTIONS AT HIGH CURRENT DENSITY

KUZ'MIN, V. A. and MNATSAKANOV, T. T.

[Abstract] The straight branch of the current-voltage characteristic of high-
voltage semiconductor devices with a diffused p-n junction and a significant
voltage drop across the base region is considered, specifically a p^+-p-n^+ struc-
ture with an exponential depthwise impurity distribution and a constant lifetime
of charge carriers in the emitter region. Boundary conditions are established
for the diffused p^+-n junction, assuming a quasi-equilibrium and quasi-neutral
state, which yield a constant injection factor. The corresponding compatible
system of differential equations yields an expression for the electric field
intensity as a function of the current density. With the aid of this expres-
sion the voltage drop across the base region, which is found to increase with
decreasing carrier lifetime, and the width of the part of the diffusion layer
swamped with mobile charge carriers at high current densities can be calculated.
Figures 3; references 17: 5 Russian, 12 Western.
[336-2415]

UDC 539.216.2

CURRENTS IN SHORT-CIRCUITED METAL-OXIDE-METAL STRUCTURES

KUNIN, V. Ya., TARNOPOL'SKIY, Yu. K. and SHTURBINA, N. A.

[Abstract] The dependence of the short-circuit currents in thin MOM structures
(Al-SiO/V_2O_5-Al, Pt-SrTa$_2$O$_6$-Al, Al-Al$_2$O$_3$-Al, Ta-Ta$_2$O$_5$-Al) on glass ceramic sub-
strates without prior polarization was measured over the 120-500 K range in the
directions of heating and cooling. The dielectric oxide layers had been deposited
by the vacuum evaporation process, by sputtering in a gas-discharge plasma, and by

electrochemical anodizing, respectively. These and the metal layers were all 200-300 nm thick, the plates of such MOM capacitors having an area of 1 mm^2. Below and above approximately 350 K the direction of the current was found to be different, as well as during heating and cooling. The experiments confirmed neither the hypothesis of a thermo-emf nor the hypothesis of a pyro-emf, indicating rather that the currents in short-circuited MOM structures are not caused by the temperature drop but by the temperature variation with time. The currents appearing in short-circuited MOM structures during heating seem to be caused by a nonuniform distribution of impurities and defects in the dielectric, one mechansim of their generation being a change of charge on the capacitor plates. This hypothesis, supported by calculations, has been confirmed by an additional experiment with a $SrTiO_3$ single crystal. Figures 3; references 12: 9 Russian, 3 Western (one in translation).
[336-2415]

POTENTIAL INPUT UNIT OF CHARGE-COUPLED DEVICE IN REGIME OF WEAK SIGNALS

VINETSKIY, Yu. R. and TRISHENKOV, M. A.

[Abstract] Input units acquire a significant value in devices based on charge-coupled devices. A number of works in the literature are devoted to such input units. However, small input signals--on the order of thermal potential and less-- are essentially not investigated. Only experimental data exist concerning their nonlinearity, a decrease of the transfer constant with input signals less than 0.1-0.5 V. In the present paper, the authors analyze an input unit with the introduction of small signals, in the course of which much consideration is given of a regime of subthermal signals. The scheme of an input unit and a profile of the surface potential with "infusion," "drainage" and "extrusion" of the charge is illustrated, and the mechanism of operation of the input unit is explained. Simple analytical approximations of precise solutions are obtained, suitable for engineering calculations. Problems are considered of the choice of regimes, compromises from the point of view of the signal-to-noise ratio, linearity and speed of response. Means for a further generalization of the model utilized are indicated. The paper has two appendices: 1) Choice of profiles of charge density in source and gate; and 2) Basis of applicability of condition of constant Fermi level in transition layer. Figures 5; references: 14 Western (one in translation).
[328-6415]

MAXIMUM SWITCHING SPEED OF P-N-P-N STRUCTURES

KUZ'MIN, V. A., PAVLIK, V. Ya, and SHUMAN, V. B.

[Abstract] The switching process in p-n-p-n structures in strong electric fields
and at high current densities is analyzed on the basis of theoretical relations
and experimental data. In the theoretical part only the drift mechanism is
assumed to operate and two stages of the transient process are considered: first
a high injection level in the weakly doped n-base and a low injection level in
the p-base, then high injection levels in both bases. The current as a function
of time is calculated for both stages from the respective continuity equations,
with the appropriate assumptions concerning the hole distribution and the boundary
conditions at the collector junction. These relations involve also the lifetime
of mobile carriers and the rate of change of current in an electric field where
the voltage drop across the structure initially decreases almost exponentially.
Experimental data were obtained with p-n-p-n structures having 16-25 micrometer
wide p-bases and 115-190 micrometer wide n-bases, the original n-type silicon
crystal having an electrical resistivity of 30 ohm·cm. The switching voltage
of these thyristors was approximately 1000 V, the current density across the
10^{-2} cm^2 large switching surface reaching 10^3-10^4 A/cm^2 and the electric field
intensity in the base regions reaching $(2-5)\cdot10^4$ V/cm. The results of this
analysis indicate that fast switching at high current density and high voltages
is caused by a short transit time through both base regions. The maximum
switching speed is proportional to the total thickness of both base layers cubed,
to the area of the initial switching surface, and to the product of the satura-
tion drift velocities of electrons and holes. Figures 3; references 10:
9 Russian, 1 Western.
[365-2415]

CURRENT-VOLTAGE CHARACTERISTIC OF LARGE-AREA P-N STRUCTURES

MNATSAKANOV, T. T., BURTSEV, E. F., KUZ'MIN, V. A., LOKTAYEV, Yu. M.,
LAPSHINA, I. N. and KONYUKHOV, A. V.

[Abstract] The current-voltage characteristic of a large-area p-n structure
and the lifetime of holes in its n-base were measured for a study of the
nonuniformity of the current distribution over the area of such a device. A
specimen of a p^+-p-n-n^+ silicon structure 40 mm in diameter was used for the
experiment, after it had been subdivided by 30 um deep grooves into small devices

1.3 mm in diameter by the photolithographic process and subsequent etching on
the n+-layer side. Across an oblique section at a 2°55' angle the profile of
impurity concentration was then also determined. The results are compared with
theoretical calculations. The differences at high current densities are attri-
buted not to fluctuations of the electrophysical properties but to a partial
swamping of the diffused p-layer with mobile carriers, which widens the base
and shortens the effective carrier lifetime depending on the magnitude of the
current: in this case at approximately 100 A/cm^2. Figures 5; references 10:
5 Russian, 5 Western.
[336-2415]

NONLINEAR MODEL OF GaAs FIELD-EFFECT TRANSISTOR WITH SCHOTTKY GATE

STAROSEL'SKIY, V. I.

[Abstract] Several models of a GaAs field-effect transistor with a Schottky
barrier have been proposed, but the simplifying assumptions on which they are
based render them inadequate for a thorough analysis and synthesis of these
nonlinear devices. Here a model is proposed in which the device parameters
are explicitly expressed through electrophysical and topological properties of
the structure, and in which the equivalent circuit is symmetric with respect
to the source and the drain. The model is universal and covers all modes of
transistor operation. It describes the current-voltage characteristic almost
correctly, only within the flat range does it incorrectly yield and infinitely
high differential output impedance. It also describes the distribution of the
gate-channel capacitance between the source electrode and the drain electrode
correctly, but it incorrectly yields a gate-drain edge capacitance independent
of the drain voltage. Despite these deficiencies, this model can be recommended
as a sufficiently simple and accurate one for analysis and design of nonlinear
electron devices of this type. Figures 4; references 17: 2 Russian, 15 Western.
[365-2415]

TEMPERATURE DEPENDENCE OF CHARACTERISTICS OF NONRECIPROCAL MICROWAVE DEVICES
UTILIZING InAs SPECIMENS

USANOV, D. A. and KABANOV, L. N.

[Abstract] This brief communication is a continuation of research done in 1974
and 1978 by the authors of the present work. It was shown by them that the
magnitudes of decoupling and the direct losses of nonreciprocal microwave de-
vices, utilizing specimens of InSb with a fixed value of the magnetic field
depend to a considerable extent on temperature. The increased level of micro-
wave power led to a change of the characteristics of nonreciprocal microwave
devices analogous to that observed with an increase of temperature. It was
also shown that strong nonreciprocalness in the propagation of waves can also
be observed with the use of InAs. As is known, indium arsenide in comparison
with indium antimonide has a larger width of the forbidden band, and consequently
it was possible to anticipate that in the neighborhood of room temperatures, the
device using InAs must have a higher temperature stability of its characteristics
in comparison with analogous devices with a semiconductor form fulfilled from
InSb. The present brief communication is dedicated to verification of this
assumption. Measurements were conducted in the 8-mm band of wavelengths (channel
of waveguide 0.72×0.34 cm^2). The specimens investigated were made of electron-
type indium arsenide. Their parameters are listed. A comparison of the charac-
ters considered conclusively shows that'the temperature stability of devices
made of InAs is best. The possibility of their operation with higher levels
of microwave power is also presented. Figures 2; references: 2 Russian.
[339-6415]

OPTIMUM DOPING PROFILE OF INJECTION-TRANSIT TIME DIODE

PAVLOV, G. P.

[Abstract] The paper is devoted to a search for the optimum doping profile
of an injection-transit time (ITT) diode. For this purpose, a method proposed
by Pavlov in 1979 is used for calculating the power characteristics of a
uniformly doped diode. The essence of this method consists of the fact that
with a replacement of the actual dependence of the carrier velocity on the
field of a piecewise linear curve, the equation of motion of the charge carriers

in the drift region becomes linear and has an analytical general solution. The diffusion of the space charge of the moving carriers and their interactions is neglected, but the effect is considered of limiting the injection by the space charge of the injected carriers and the dependence of the carrier velocity on the field. It is shown that in an optimum structure, power as a function of the voltage amplitude increases more rapidly than in an ordinary diode because losses in the positive half-cycle are smaller. In addition, in consequence of the specific form of modulation of the velocity field, the microwave field is weaker, and consequently limitation of the power advances at large amplitudes. All this makes it possible to attain a maximum power three times higher than with a similar diode and to increase efficiency approximately one and one half times. Figures 2; references 5: 2 Russian, 3 Western.
[339-6415]

CORRELATION CHARACTERISTICS OF MAGNETIC FLICKER NOISE SPECTRAL COMPONENTS

BUKHAROV, M. V. and KOLACHEVSKIY, N. N.

[Abstract] An experimental study was made to determine the dependence of the
correlation coefficients for the spectral components of magnetic flicker noise
during magnetization reversal in ferromagnetic cores on the amplitude of the
excitation field and on the magnitude of the constant bias field. Measurements
were made on cores of 87N2M and 40NKM alloys with an almost rectangular hysteresis
loop. The specimens were placed inside a cylindrical magnetic shield effectively
suppressing the earth's magnetic field and were magnetized with the current from
a 700 Hz sine-wave generator. The bias field was supplied from a high stable
d.c. current source. The results are now interpreted according to the theory
of magnetization reversal in soft magnetic materials with an ideally rectangular
hysteresis loop, using the Fourier series expansion and some simplifying approxi-
mations for the few lower-order harmonics. The analysis reveals a modulation
mechanism of magnetic flicker noise near the frequency of magnetization reversals,
it also validates the model of slowly fluctuating coercive force and amplitudinal
magnetization. Symmetric fluctuations of the latter generate noise near odd
harmonics and the noise component multiplicative to the bias field near even
harmonics. Asymmetric fluctuations of both generate the noise component addi-
tive to the bias field near even harmonics. The additive noise component near
even harmonics and the noise near odd harmonics are not correlated, however,
unless the core is in a relatively strong constant or slowly varying external
or internal magnetic field. Figures 7; references 8: 7 Russian, 1 Western
(in translation)
[336-2415]

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